Master of Computer Applications (MCA)

Database Management System Lab

(OMCACO108P24)

Self-Learning Material

(SEM 1)

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COURSE INTRODUCTION

Database Management Systems (DBMS) are fundamental in today's data-centric world, offering a structured approach to storing, managing, and retrieving vast amounts of information efficiently. A DBMS serves as an intermediary between users and the database, allowing users to define, create, maintain, and control access to data. It abstracts the complexities of data management, enabling seamless interaction with databases for a wide range of applications, from enterprise solutions to personal data handling.

To begin with, students will explore different database models, focusing primarily on the relational model, which organizes data into tables with rows and columns. Understanding database models is crucial as it dictates how data is structured and queried. The course will also delve into data modeling techniques, including the creation of Entity-Relationship (ER) diagrams, which visually represent data entities, their attributes, and the relationships between them. This foundational knowledge will be translated into practical database schemas.

A significant portion of the course will be dedicated to SQL (Structured Query Language), the standard language used to interact with relational databases. Students will develop skills in writing SQL queries to perform essential operations such as data retrieval, insertion, updating, and deletion. Advanced SQL topics, including joins, subqueries, and transactions, will also be covered to provide a deeper understanding of complex data manipulation.

Transaction management is another crucial topic, focusing on how databases handle transactions to maintain data consistency and reliability. Students will learn about transaction properties (ACID properties), concurrency control mechanisms, and recovery strategies to ensure the integrity of database operations.

Additionally, the course will introduce non-relational (NoSQL) databases, which handle unstructured and semi-structured data differently from relational databases. Students will gain insights into various types of NoSQL databases, such as document stores, key-value stores, and column-family stores, and understand their applications in different scenarios.

Course Outcomes:

At the completion of the course, a student will be able to:

1. Demonstrate an understanding of the elementary & advanced features of DBMS & RDBMS.
2. Develop a clear understanding of the conceptual frameworks and definitions of specific terms that are integral to the Relational Database Management
3. Attain a good practical understanding of SQL.
4. Develop clear concepts about Relational Model.
5. Examine techniques pertaining to Database design practices
6. Prepare various database tables and joins them using SQL commands
7. Understand the basic concepts of Concurrency Control & database security
8. Understand the basic concept how storage techniques are used to backup data and maintain data access performance in peak hours
9. Evaluate options to make informed decisions that meet data storage, processing, and retrieval needs.

Acknowledgements:

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1. Install OracleRDBMSand create a Database.

Installing “Oracle RDBMS” and creating a Database is a multi-step process that can be broken down into the following steps:

- Download Oracle Database Software: Go to the Oracle Database download page(https://www.oracle.com/database/technologies/) and choose the version you want to install (e.g., Oracle Database 19c). Download the proper installer for your operating system (Linux, Windows,ormacOS).
- Install the Oracle Database Software: Follow the setting up steps specific to your Operating system. For detailed instructions, consult Database of Oracle InstallationGuide (https://docs.oracle.com/en/database/oracle/oracle-database/index.html) for your chosen version and operating system.
- create an Oracle Database: After installing “Oracle Database” software, you can createa

“Database using the Database Configuration Assistant” (DBCA). Follow these steps:

a. Open the database Configuration Assistant:

- On Windows, click "Start," search for "Database Configuration Assistant" and click on it.
- On Linux, open a terminal and enter **dbca** to launch the Database ConfigurationAssistant.

b. Choose"Create a Database" and click "Next."

Choose the appropriate template for your database (e.g., General Purpose or TransactionProcessing) and click"Next."

Enter a Global Database Name and System Identifier “SID” for your database. The GlobalDatabase Name should be in the format "database_name.domain_name" (e.g.,"mydb.example.com"). The SID is a unique identifier for your database instance. Click"Next."

c. Choose the storage options for your database, such as file system or Automatic StorageManagement (ASM).Click"Next."

d.Set the memory allocation for your database by choosing either automatic or custom memory management. Click "Next."

e. Choosetheappropriatecharactersetforyourdatabaseandclick"Next."

f. Configure security settings for your database, such as enabling Transparent DataEncryption(TDE)andsettingapasswordfortheSYSandSYSTEMaccounts.Click"Next."

g. C onfigure the management options for your database, such as enabling Oracle EnterpriseManagerDatabaseExpress and setting a password for the DBSNMP account. Click "Next."

h. R
eview the summary of your database configuration and click "Finish" to create the database.

- **join to the Oracle Database:** Use SQL*Plus, SQL Developer, or another database management tool on the way to connect to your newly created Oracle Database using the connection details (SID, username, and password) you provided during the database creation process.

Now you have installed Oracle RDBMS and created a database. You can start creating tables,inserting data, and querying the database as needed

2. **Familiarize yourself with Oracle SQL Developer or another Oracle-compatible SQLclient.**

“Oracle SQL” Developer is a popular, free “Integrated Development Environment” (IDE) that simplify working with Oracle databases. It provides a powerful and intuitive interface formanagingdatabaseobjects, running “SQLqueries” ,and developing “PL/SQL code”.

Here's how to get started with “OracleSQLDeveloper “:

1. Download “Oracle SQL” Developer: Go to the Oracle SQL Developer download page(https://www.oracle.com/tools/downloads/sqldev-downloads.html) and download the appropriate version for your operating system(Windows,macOS,or Linux).

2. Installing Oracle SQL Developer: Follow the installation instruction for your operating system provided in the Oracle SQL Developer documentation(https://docs.oracle.com/en/database/oracle/sql-developer/index.html).

3. Launch Oracle SQL Developer: Start Oracle SQL Developer by running the executable file (sqldeveloper.exe on Windows or sqldeveloper.sh on Linux/macOS) located in the installation folder.

4. Create a Database Connection: To connect to your Oracle Database, you need to setup a fresh database connection. Click the "+" icon within the "Connections" tab in the left pane to open the "NewConnection" dialog.

Fill in the required details, such as:

- ConnectionName:A Unique Name For The Connection.
- Username: The database user account (e.g., SYSTEM or another user account you've created).
- Password:The Password For The User Account.

- Hostname:Thehostnameor “IPaddress”oftheserver hostyourOracleDatabase.
- Port :Thelistenerportfor your OracleDatabase(default is1521).
- SID or Service Name:The SID or Service Name of your Oracle Database.

Click "Test" to ensure the connection settings are correct, then click "Connect" to establish a connection to the database.

5. Explore Oracle SQL Developer Features: With Oracle SQL Developer, you can manage your database, develop and debug PL/SQL code, run SQL queries, and more.Familiarizeyourself with the following features:

- SQL Worksheet: Write, execute, and save SQL queries, PL/SQL code, and scripts.Access it by right-clicking a connection and selecting "Open SQL Worksheet" or clicking the"SQLWorksheet"button toolbar.
- Object Browser: Explore and manage database objects (tables, indexes, views, etc.)in the "Connections" tab. You can create, edit, and delete objects by right-clicking selecting the appropriate options.
- Data Import and Export: Import data from external files (CSV, Excel, XML, etc.) or export data from tables and views to various file formats. Access these options byright-clickingatableorviewandselecting"ImportData" or"ExportData."
- PL/SQL Debugging: Debug PL/SQL code by setting breakpoints, stepping through code, and examining variable values. Open a PL/SQL object (procedure, function,package, etc.) in the editor, set breakpoints, and click the "Debug" button on the toolbar to start a debugging session.

3. Create a schema for a university, including tables for students, courses, and instructors.

```
-- Creating table for studentsCREATETABLEstudents(

Student_id NUMBER PRIMARY KEY,

First_nameVARCHAR2(50),Last_name VARCHAR2(50),Birth_dateDATE,

  majorVARCHAR2(50)

);

-- Creating table for coursesCREATE TABLE courses (
```

course_id NUMBER PRIMARY KEY,course_name VARCHAR2(100), course_description VARCHAR2(1000), instructor_id NUMBER);

-- Creating table for instructors CREATE TABLE instructors (instructor_id NUMBER PRIMARY KEY, first_name VARCHAR2(50), last_name VARCHAR2(50), department VARCHAR2(50)

);

-- Add foreign key constraint on courses referencing instructorsALTERTABLE courses

ADDCONSTRAINTfk_instructorFOREIGN KEY (instructor_id)REFERENCESinstructors(instructor_id);

4. **Write SQL queries insert data into the tables created.**

--Inserting data into instructors table

INSERT INTO instructors (instructor_id, first_name, last_name, department)VALUES(1, 'John','Doe','Computer Science');

--Inserting data into student table

INSERT INTO students (student_id, first_name, last_name, birth_date, major)VALUES(1,'Jane','Smith',TO_DATE('1998-05-17','YYYY-MM-DD'),'Computer Science');

--Inserting data into courses table

5. **Writea query to retrieve every students from the student table.**

```
SELECT*FROMstudents;
```

Output:

```
STUDENT_ID|FIRST_NAME|LAST_NAME| BIRTH_DATE|MAJOR

  -.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.-.

1      |Jane       | Smith    | 17-MAY-98| Computer Science
```

6. **Create a database called "College" with two tables named "Students" and "Courses".Then, insert sample data into these tables and perform a simple join operation to retrieve student names along with the courses they are enrolled in.**

- **Creating the"College" database:**

```
CREATEDATABASECollege;
```

- **createthe"Students"table:**

```
USE College;

CREATE TABLE Students

  (Student_idINTPRIMAR

  YKEY,

  student_Name   VARCHAR(50)

  NOT NULL,Course_idINT

);
```

- **Createthe"Courses"table:**

```
CREATE      TABLE

  Courses

  (Course_idINTPRI

  MARYKEY,

  course_name VARCHAR(50) NOTNULL

);
```

- **Insert sample data into the "Students" table:**

```
INSERT  INTO  students  (student_id,  student_name,

Course_id)VALUES  (1, 'Alice',101),

    (2,                                                              'Bob',102),
```

(3,'Charlie',101);

- **insert sample data into the "Courses"table:**INSERT INTO Courses (course_id, course_name)VALUES(101, 'Mathematics'),

  (102,'Physics');

- **Performing a simple join operation to retrieve student names all along with the coursestheyareenrolledin:**

```
SELECT student_nameand
course_nameFROMStudents
JOINCoursesONStudents.Course_id withCourses.course_id;
```

7. Write a query to find the courses by the highest and lowest number of registered students.

```
WITH Course Counts AS(
  SELECT Course_id, COUNT(student_id) AS
  num_students

  FROM Students
  GROUPBYCourse_id

)
, MinMaxCountsAS(
  SELECT MIN(num_students) AS min_students, MAX(num_students) AS
  max_students FROM Course Counts
)
SELECT Courses.course_id, Courses.course_name,
CourseCounts.num_students FROM Courses
JOIN CourseCounts ON Courses.course_id=CourseCounts.course_id
JOIN MinMaxCounts ON CourseCounts.num_students =
          MinMaxCounts.min_students OR
          CourseCounts.num_students=MinMaxCounts.max_students;
```

This Query Consists Of Three Parts:

1. The **CourseCounts** Common Table Expression (CTE) calculate the number of registered student for each course by grouping the **Students** table by **course_id** and counting the **student_id**s.
2. The **MinMaxCounts** CTE finds the minimum and maximum number of registered students among all courses by selecting the **MIN** and **MAX** of the **num_students** column from the **Course Counts** CTE.
3. The key query joins the **Courses**, **CourseCounts**, and **MinMaxCounts** tables to find and display the course ID, course name, and amount of registered students for thecourses withthehighestandlowestnumberofregisteredstudents.

8. Write a querytoretrievetheaverageGPAofstudentsineach course.

```
SELECT Courses.course_id, Courses.course_name, AVG(Students.GPA) AS
average_gpa FROM Students
JOIN Courses ON Students.course_id with Courses.course_id
GROUPBY Courses.course_id,Courses.course_name;
```

This query performs the following operations:

1. join the **Students** and **Course s**tables on the **course_id** column.
2. group the joined records by **course_id** and **course_name**(from the **Courses**table).
3. Calculates the Average GPA students in each group using the AVG**()** function.

The result of this query will display the course ID, course name, and average GPA of students in each course.

9. Write a query to update a studentGPA.

To revise a student's GPA, you would first need to know the structure of your database,particularly the name of the table that holds the student information and the names of the columns for the student ID and GPA. Assuming the table name is "students" and the columns are"student_id" and"gpa", you could write a query like this:

```
UPDATE
studentsSETgpa=ne
w_gpa
WHEREstudent_id                                    =target_student_id;
```

Replace new_gpa with the updated GPA value (e.g., 3.5) and target_student_id with the ID of the student whose GPA you desire to update (e.g., 12345). Your final query would look like this:

```
UPDATE
studentsSETgpa=
3.5
WHEREstudent_id=12345;
```

Before running the query, make sure to replace the table and column names if they are different in your database.

10. Write A query to update a course's credit hours.

To update a course's credit hours, you would need to know the structure of your database,specifically the name of the table holding the course information and the names of the columns for the course ID and credit hours. Assuming the table name is "courses" and thecolumnsare"course_id"and"credit_hours", you could write a query like this:

```
UPDATE courses
SET credit_hours = new_credit_hours WHERE course_id =
target_course_id;
```

Replace new_credit_hours with the updated credit hours value (e.g., 4) andtarget_course_id with the ID of the course whose credit hours you want to update (e.g.,'CSCI101'). Your final query would look like this:

```
UPDATEcoursesSE
Tcredit_hours=4
WHERE course_id = 'CSCI101';
```

11. Writea query to delete a student from the student table.

```
DELETE FROM student
WHEREstudent_id=<student_id_to_delete>;
```

12. Write a query to drop the course registration table.

```
DROPTABLEcourse_registration;
```

13. Createatableforstoringstudentaddresses.

```
CREATE TABLE student_addresses(address_idSERIALPRIMARYKEY,
   Student_id INT REFERENCES student (student_id),streetVARCHAR(250),
   city VARCHAR(255),stateVARCHAR(255),
   postal_code VARCHAR(255),countryVARCHAR(255)
);
```

14. Write SQLqueriestoinsertDataintothe student addressestable.

```
INSERT INTO student_addresses (student_id, street, city, state, postal_code,
country)VALUES(<student_id>, '<street>','<city>',
'<state>','<postal_code>','<country>');
```

15. Write aquerytoretrieveaspecificstudent'saddressbytheirstudentID.

```
SELECT*FROMStudent_addresses
WHEREStudent_id=<Student_id_to_search>;
```

16. Write aquerytodeleteastudent'saddressas ofthestudentaddressestable.

```
DELETEFROMstudent_addresses
WHEREStudent_id=1;--Replace1withthedesiredstudentID
```

17. Create a table for storing instructor's office hours.

```
CREATE TABLE instructor_office_hours(id SERIAL PRIMARYKEY,
   instructor_id INT NOT NULL,day_of_week VARCHAR(15) NOT
   NULL,start_timeTIMENOTNULL,
   End_timeTIMENOTNULL
```

18. Write SQL queries add data into the instructor office hours table.

```
INSERT INTO instructor_office_hours (instructor_id, Day_of_week, start_time,
end_time) VALUES (1,'Monday','10:00:00', '11:00:00');

INSERT INTO instructor_office_hours (instructor_id, Day_of_week, start_time,
end_time)VALUES (2, 'Tuesday', '14:00:00', '16:00:00');

INSERT INTO instructor_office_hours (instructor_id, Day_of_week, start_time,
end_time)VALUES(1,'Thursday','10:00:00', '12:00:00');
```

19. Write a query to retrieve all instructor office hours.

```
SELECT*FROMinstructor_office_hours;
```

20. Writea query to retrieve a specific instructor's office hours their employeeID.

```
SELECT*FROMinstructor_office_hours
WHEREinstructor_id=1;--Replace1 with the desired instructor ID
```

21. Write A Query To Update An Instructor's Office Hours.

```
    UPDATEinstructor_office_hours
    SETStart_time= '11:00:00',end_time='13:00:00'
    WHERE id=1;--Replace1 with thedesiredofficehours record ID
```

22. Write a query to delete an instructor's office hours from the instructor office hours table.

```
DELETEFROM instructor_office_hours
WHERE id=1;--Replace1 with the desired office hours record ID
```

23. Create a A table for storing course prerequisites.

```
CREATE TABLE Course_prerequisites(id SERIAL PRIMARYKEY,
    course_id INT NOT  NULL, prerequisite_id INT NOT NULL
);
```

24. **Consider a table named '\Employees' with the following columns: employee_id,first_name, last_name, age, department, and salary. Write a ”SQL query” to display the first name, last name, and salary of all employees working within the 'Finance Department.**

```
SELECT     First_name     ,last_name,
salaryFROMEmployees
WHERE
Department='Finance';
```

25. **Consider a table named 'Students' by the follow columns: student_id, first_name,last_name, age, grade, and course_id. Write a SQL query to compute the average age of students grade 10.**

```
SELECT AVG(age) AS average_age FROM Students
WHERE grade=10;
```

26. **Consider two tables named 'Orders’ and 'Order_items'. The 'orders' table has the columns order_id, , and order_date, customer_id. The 'order_items' table has the column order_id, product_id, quantity, with price. Write a “SQL query” to find the total revenue generated on a specific date (e.g., '2023-03-31').**

```
SELECT SUM(quantity * price) AS total_revenue FROM orders
JOIN orders.order_id ON order_items = order_id.order_item WHERE order_date
='2023-03-31';
```

27. **Consider a table name 'products' by the following columns: product_id, product_name, category, and price. write down a SQL query to display the three most expensive products in each category.**

```
SELECT     p1.product_id,     p1.product_name,     p1.category,
p1.price                         FROM                         productsp1
```

```
WHERE (SELECT COUNT(*)
  FROM productsp2
  WHERE p2.category= P1.category ANDp2.price> P1.price
) < 3
ORDERBY p1.category,p1.priceDESC;
```

28. **Consider a table name 'customers' by the next columns: customer_id,first_name, last_name, Email, and Phone. Write down a SQL query to update the phone numbers of customers with the last name 'Smith' by adding a '+1' prefix.**

```
UPDATE customers
SET phone = CONCAT('+1', phone) WHERE last_name = 'Smith';
```

29. **Consider a table name 'books' with the next columns: book_id, title, author,genre, in addition to publication_year. Write down a SQL query to count the number of books published in each genre after 2010.**

```
SELECT genre, COUNT(*) AS book_count FROM books
WHERE publication_year> 2010 GROUPBYgenre;
```

30. **Consider two tables name 'authors' and 'books'. The 'authors' table have the columnsauthor_id, first_name, and last_name. The 'books' table has the columns book_id,title, author_id, and publication_year. Write down a SQL query to display the list of authors who have published at least three books.**

```
“SELECT a.author_id, a.first_name, a.last_name, COUNT(b.book_id) AS
book_count FROM authors a
JOIN books b ON a.author_id = b.author_idGROUP BY a.author_id, a.first_name,
a.last_nameHAVINGCOUNT(b.book_id) >=3;”
```

31. **ConsIder a table name 'inventory' by the following columns: product_id,product_name, quantity, and price. Write down a “SQL query” to display the total value of the inventory(quantity*price)for each product with a value greaterthan1000.**

```
SELECTproduct_id, product_name, quantity, price, (quantity*price) AS inventory_value
```

```
FROM inventory
WHERE (quantity*price)>1000;
```

32. **Consider a table name 'events' with the following columns: event_id, event_name,start_date, end_date, and venue. Write down a SQL query to display the events scheduled to occur between '2023-04-02'and'2023-04-30', sortedbystart_date.**

```
SELECT event_id, event_name, start_date, end_date, venue FROM events
WHERE start_date BETWEEN '2023-04-02'AND'2023-04-30'
ORDERBY start_date;
```

33. **Consider a table named 'users' with the following columns: user_Id, username, email,and registration_dAte. Write a SQL query to delete all users who registered more than two years ago(assuming the current date is '2023-03-31').**

```
DELETE FROM users
WHERE registration_date<DATE_SUB  ('2023-03-31',INTERVAL 2 YEAR);
```

34. **Consider a table name 'sales’ with the following columns: sale_id, product_id,sale_date, and quantity. Write down a “SQL query” to display the total number of sales for every month in 2022.**

```
“SELECT YEAR ( sale_date) AS sale_y
Eear  , MONTH(sale_date) AS sale_month, COUNT(*) AS sale_count
FROM sales
WHERE YEAR(sale_date) = 2022 GROUPBYsale_year,sale_month;”
```

35. **Consider two tables named 'students' and 'enrollments'. The 'students' table has thecolumns student_id, first_name, and last_name. The 'enrollments' table has the columns enrollment_Id, student_id, course_id, and semester. Writedown a SQL query to display the list of students who are not enrolled in a few courses for the 'Spring 2023 semester.**

```
“SELECT s.student_id, s.first_name,
s.last_name FROM students
LEFT JOIN enrollments e ON s.student_id = e.student_id AND e.semester = 'Spring
2023 WHERE e.enrollment_idISNULL;”
```

36. **Consider a table name 'orders' with the following columns: order_id, customer_id,order_date, and total_amount. Write down a “SQL query” to find the total revenue generated per month in 2022.**

```
“SELECT YEAR(oRder_date) AS order_year, MONTH(oRder_date) AS
order_month,SUM(total_amount) AS monthly_revenue
FROMoRders
WHERE YEAR(order_date) = 2022 GROUPBY order_year, order_month;”
```

37. Consider a table name 'employees' by the following columns: employee_id, first_name, last_name, hire_date, and salary. Write down a SQL query to display the employees hired within the last 6 months(assuming the current date is'2023-03-31').

```
“SELECT employee_id, first_name, last_name, hire_date, salary FROM employees
WHERE hire_date>DATE_SUB('2023-03-31', INTERVAL 6 MONTH);”
```

38. Consider a table named 'cities' with the following columns: city_id, city_name,country, and population. Write down a SQL query to display the top 5 most populous cities in ascending order.

```
SELECT city_id, city_name, country, population FROM cities
ORDER BY population DESC LIMIT 5;
```

39. Consider a table name 'employees' with the following columns: employee_id, first_name, last_name, department, and salary. Write down a SQL query to find the employees with the highest salary in each department.

Step1:
First, we need to find the highest salary for each department. To do this, we use the GROUP BY clause to group the records in the department and the MAX() function to get the greatest salary in each group.

```
SELECT department, MAX(salary) AS highest_salary FROM employees
GROUP BY department;
```

Step2:
Now that we have the highest salary for each department, we need to join the result of the previous query with the original 'employees' table to get the employee details.

```
SELECT e.employee_id, e.department, e.first_name, e.salary FROM employees
,e.last_name JOIN (
 SELECT department, MAX (Salary) AShighest_Salary
```

```
  FROM employees GROUP BY department
)ON e.department=d.department AND e.salary=d.highest_salary;
```

The inner query (subquery) calculates calculates the highest salary designed for each department, and the outer query joins the 'employees' table with the result of the subquery to get the employee details.

40. Consider two tables named 'students' and 'courses'. The 'students' table has the columns first_name, student_id, and last_name . The 'courses' table has the columns course_id, course_name, with instructor. Write a SQL query to find the students who have not taken any courses taught by a specific instructor (e.g.,'JohnSmith').

Step 1:
Filter the 'courses' table to get the courses taught by the specific instructor.SELECT course_id
FROM courses
WHERE instructor='JohnSmith';

Step2:
Join the 'students' table by the 'courses' table using a LEFT JOIN to get the list of students who have taken courses taught by the specific instructor. Filter the result to include only students who haven't taken any of the instructor's courses.

```
SELECT DISTINCT s.student_id, s.first_name, s.last_name FROM students
LEFT JOIN courses c ON s.course_id = c.course_id AND c.instructor = 'John
Smith' WHERE c.course_id IS NULL;
```

The LEFT JOIN ensures that all students are included in the result, even if they haven't taken any courses taught by the specific instructor. The DISTINCT keyword is used to remove duplicate entries in case a student is enrolled in multiple courses not taught by the instructor.

41. Write a query to locate the courses offered in a specific semester.

```
SELECT*FROM

coursesWHERE

semester='Fall2023';
```

42. Write a query to find the instructor's teaching specific course.

```
“SELECT i.instructor_id ,i.instructor_name FROM instructors JOIN course_instructors.ci ON
i.instructor_id = ci.instructor_id WHERE ci.course_id = 'CS101' ;”
```

43. Write a query to locate the students by the highest GPA in a specific course.

```
SELECT s.student_id, s.student_name, s.gpa FROM students sJOINcourse_registrationscr ON
s.student_id = cr.student_id WHERE cr.course_id ='CS101'ANDs.gpa =(
 SELECT MAX(gpa) FROM students st
 JOIN course_registrationscrt ON st.student_id = crt.student_id WHERE crt.course_id =
 'CS101'
);
```

44. Writea query to find courses by means of non registered students.

```
“SELECT c.course_id, c.course_name FROM courses
LEFT JOIN course_registrationscr ON c.course_id = cr.course_id WHERE cr.student_id IS
NULL;”
```

45. Writea Querytolocatethe top 4 students with the highest GPA.

```
SELECT id, name, GPAFROMstudentsORDER By GPA DESC LIMIT 4 ;
```

46. Write a query to find theTop 5 course with the maximum averageGPA.

```
“SELECT c.id, c.name, AVG(r.grade) as average_gpaFROMcourses c
JOiN registrations r ON c.id = r.course_idGROUPBYc.id,c.name
ORDER BY average_gpa DESC
LIMIT                                                                    5;”
```

47. Write a query to find theTop 5 instructors with the HighestaveragestudentGPA.

```
SELECT i.id, i.name, AVG(r.grade) as
average_gpaFROM instructors i
JOIN course_instructors ci ON i.id =
ci.instructor_idJOIN registrations r ON
ci.course_id = r.course_idGROUPBYi.id,i.name
ORDER BY average_gpa
DESC LIMIT 5;
```

48. Create a view to display the student ID, name, and total credit hours of the course they are registered for.

```
CREATEVIEWstudent_credit_hoursAS
SELECT s.id as student_id, s.name as student_name, SUM(c.credit_hours)
astotal_credit_hours
FROMstudentss
JOIN registrations r ON s.id =
r.student_idJOIN courses c ON
r.course_id = c.idGROUPBYs.id,s.name;
```

49. Create a view to display the instructor ID, name, and total credit hours of the courses they are teaching.

```
CREATE VIEWinstructor_credit_hoursAS
SELECT i.id as instructor_id, i.name as instructor_name, SUM(c.credit_hours)
astotal_credit_hours
FROM instructorsi
JOIN course_instructors ci ON i.id =
ci.instructor_idJOINcourses cONci.course_id= c.id
GROUPBYi.id,i.name;
```

50. Createastoredproceduretoenrollastudentinacourse.

```
CREATE PROCEDURE
EnrollStudent@StudentIDINT,
@CourseID
INTAS
BEGIN
INSERT INTO Enrollment (StudentID,
CourseID)VALUES(@StudentID,@CourseID)
;
END
;GO
```

51. Createastoreproceduretodropacourseused forastudent.

```
CREATE PROCEDURE
DropCourse@studentIDINT,
@courseID
INTAS
BEGIN
DELETEFROM Enrollment
WHERE StudentID = @StudentID AND courseID =
@courseID;END;
GO
```

52. Create a stored procedure to add a fresh course to the course table.

```
CREATE PROCEDURE AddCourse
@CourseID INT,
@CourseNameNVARCHAR(25
5),@CreditHoursINT
ASBE
GIN
```

```
INSERT INTO Courses (CourseID, CourseName,
CreditHours)VALUES(@CourseID,@CourseName,@CreditHours);
    END;GO
```

53. Create a stored procedure to delete courses from the course table.

```
CREATE PROCEDURE DeleteCourse@courseID INT
ASBEGIN
DELETEFROMCourses
WHERE CourseID = @CourseID;END;
GO
```

54. Create a stored procedure to add an instructor to the instructor table.

```
CREATE PROCEDURE
AddInstructor@InstructorIDINT,@InstructorNameNVARCHAR(255),@OfficeHoursNV
ARCHAR(255)
ASBEGIN
INSERT INTO Instructors (InstructorID, InstructorName,
OfficeHours)VALUES(@InstructorID,@InstructorName,@OfficeHours);
END;GO
```

55. Create a stored procedure to delete instructors from the instructor table.

```
CREATE PROCEDURE DeleteInstructor
@InstructorID INTAS
BEGIN
DELETEFROMInstructors
WHERE InstructorID = @InstructorID;END;
GO
```

56. Createa stored procedure to revise astudent'sGPA.

```
CREATE PROCEDURE UpdateStudentGPA@StudentIDINT,
@NewGPADECIMAL(4, 2)AS
BEGIN
UPDATEStudents
SET GPA=@NewGPA
WHERE StudentID = @StudentID;END;
GO
```

57. Createastoreproceduretobring up to dateacourse'scredithours.

```
CREATE PROCEDURE UpdateCourseCreditHours@CourseID INT,
@NewCreditHours INTAS
BEGIN
UPDATECourses
SET CreditHours = @NewCreditHoursWHERECourseID=@CourseID;
```

```
END
;GO
```

58. Createastoredproceduretoupdateaninstructor'sofficehours.

```
CREATE PROCEDURE
UpdateInstructorOfficeHours@InstructorIDINT,
@NewOfficeHoursNVARCHAR(2
55)AS
BEGIN
UPDATEInstructors
SET OfficeHours =
@NewOfficeHoursWHERE
InstructorID = @InstructorID;END;
GO
```

59. Create a function to compute the average GPA of students in a specific course.

```
CREATE FUNCTION AvgGPAByCourse
(@CourseID INT)RETURNS DeCIMAL(4,2)
ASBE
GIN
RETURN (
SELECT AVG(GPA)
FROMStudents
JOIN EnrollMent ON Students.StudentID =
Enrollment.StudentIDWHEREEnrollMent.CoUrseID=@CoUrse
ID
);EN
D;G
O
```

60. Createafunctiontocomputethetotalcredithoursearnedbyaspecificstudent.

Assuming you have a table enrollments by columns student_id, course_id, andcredit_hours, the function to calculate the total credit hours earned by a specific students can be created as follows:

```
CREATE  FUNCTION  total_credit_hours_student(student_idInT)  RETURNS  INT
AS $$DECLARE
  total_hours
INT;BEGIN
  SELECT SUM(credit_hours)INTOtotal_hoursFROMenrollmentsWHEREstudent_id=
$1;
  RETURN
total_hours;END;
$$LANGUAGEplpgsql;
```

61. Create a function to calculate the total credit hours taught by a specific instructor.

To calculate the whole credit hours taught by a specific instructor, you can create a similar function. Assuming you have a table courses with columns instructor_id andcredit_hours:

```
CREATE FUNCTION total_credit_hours_instructor(instrUctor_id INT) RETuRNS INT
AS $$DECLARE
  TOTAl_hours
INT;BEiIN
  SELECT SUM(credit_hours) INTO tOtal_hours FROM courses WHERE instructor_id
  = $1;RETURNtotal_hours;
END;
$$LANGUAGEplpgsql;
```

62. Create a trigger to update the total credit hours earned by a student when they enroll or drop a course.

Assuming you have a table students with columns id and total_credit_hours, create a trigger to update the total credit hours earned by a student when they enroll or drop a course:

```
CREATEORREPLACEFUNCTIONupdate_student_credit_hours()RETURNSTRIGGERAS
$$BE

GIN

  IF(TG_oP='INSERT')THEN

    UPDATE students SET total_credit_hours = total_credit_hours +
NEW.credit_hoursWHEREid=NEW.student_id;

  ELSIF (TG_OP = 'DELETE')THEN

    UPDATE students SET total_credit_hours = total_credit_hours -
OLD.credit_hoursWHEREid=OLD.student_id;

  ENDIF;RET

URN

NULL;END;

$$LANGUAGEplpGsql;


CREATE                                   TRIGGER

update_student_credit_hours_triggerAFTER    INSERT

OR DELETE ONenrollments

FOR each ROW EXECUTEFUNCTIONupdate_student_credit_hours();
```

63. **Create a trigger to update the total credit hours earned by a student when they enroll or drop a course.**

Assuming you have a table instructors with columns id and total_credit_hours_taught,create a trigger to update the total credit hours taught by an instructor when they areassignedorremovedfrom acourse:CREATEOR REPLACEFUNCTION Update_instructor_credit_hours()RETURNS TRIGGER AS

```
$$BE

GIN

  IF(TG_OP='INSERT')THEN

    UPDATE instructors SET total_credit_hours_taught = total_credit_hours_taught
+NEW.credit_hoursWHERE id = NEW.instructor_id;

  ELSIF (TG_OP = 'DELETE')THEN

    UPDATE instructors SET total_credit_hours_taught = total_credit_hours_taught
-OLD.credit_hoursWHEREid=OLD.instructor_id;
```

```
  ENDIF
;RETURN
   NULL;
  END ;
$$LANGUAGEplpGsql;

CREATE                                   TRIGGER
update_instructor_credit_hours_triggerAFTER   INSERT
OR DELETE ONcourses
FOREACHROWEXECUTEFUNCTIONupdate_instructor_credit_hours();
```

64. Create a table for storing user login logs.

```
CREATE            TABLE
  user_login_logs(idSERIAl
  PRIMARYKEY ,
  user_idINTNOTNULL,
  login_timestampTIMESTAMPNOTNULL

);
```

65. Write SQL queries to add data into the user login logs table.INSERT INTO user_login_logs (user_id, login_timestamp)VALUES (1, '2023-03-3110:00:00');

```
INSERT     INTO     user_login_logs     (user_id,
login_timestamp)VALUES (2, '2023-03-3110:05:00');

INSERT     INTO     user_login_logs     (user_id,
login_timestamp)VALUES (1, '2023-03-3114:00:00');
```

66. Writea query to retrieve a specific user's login logs BytheiruserID.

```
SELECT  *FROMuser_login_logs
WHERE                                  User_id=1;--Replace1withthedesireduserID
```

67. Writea querytodeleteaspecificuser'sloginlogsfromtheuserloginlogstable.

```
DELETEFROMuser_login_logs

WHERE user_id=1;--Replace1withthedesireduserID
```

68. Create An Index on the student table to improve performance.

```
CREATEINDEX idx_student_last_Name

ON student (last_name); -- Replace 'student' with your actual student table and'last_name'withthedesiredcolumn
```

69. CreateanIndexonthecoursetableto improve query performance.

```
CREATE INDEXidx_course_name

ON course (name); -- Replace 'course' with your actual course table and 'name' with the desired column
```

70. AnalyzetheperformanceofaspecificqueryusingtheOracleExplainPlanfeature.

To analyze the concert of a specific query, you can use the EXPLAIN PLAN statement inOracle. Here is a case of how to use the EXPLAIN PLAN feature:

```
-- Replace the SELECT statement with your specific

queryEXPLAINPLAN FOR

SELECT *FROMuser_login_logs WHEREuser_id=1;


-- To view the output of the EXPLAIN PLAN, you can query the

PLAN_TABLE:SELECT*FROM TABLE(DBMS_XPLAN.DISPLAY());
```

71. Use SQL subqueries to find students who are registered for the same course as a specific student.

```
SELECT DISTINCT s2.student_id,

s2.student_nameFROM course_registrationAS

cr1

JOIN course_registration AS cr2 ON cr1.Course_id =

cr2.course_idJOINstudent ASs2ONcr2.stuDent_id= s2.student_id



WHEREcr1.student_id=<specific_stuDent_id>ANDcr1.student_id!=s2.student_id;
```

72. Use SQL subqueries to find instructors who have taught the same course as a specific instructor.

```
“SELECT DISTINCT i2.instructor_id,
i2.instructor_nameFROM courseAs c1
JOINcourseAS c2ONc1.Course_id=c2.course_id
JOINinstructorASi2ONc2.instructOr_Id = i2.instructor_id
WHERE Ec1.instructor_id=<specific_instructor_id>ANDc1.instructor_id!=i2.instructor_id;”
```

73. Write a query to implement pagination for a large result set, such as a list of all students.

```
SELECT * FROM
studentORDER BY
student_id
LIMIT <page_size> OFFSET <offset>;
```

Replace <page_size> with the number of records per page and <offset> with the starting record number forthepage (e.g.,(page_number - 1)*page_size).

74. Write a query to implement full-text search for student names or course titles.

```
--For
studentnamesSELECT*F
ROMstudent
WHEREto_tsvector('enGlish',student_name)@@to_tsquery('english','<search_query>');
--For
coursetitlesSELECT*F
ROMcourse
WHERE to_tsvector('english', course_title) @@ to_tsquery('english',
'<search_query>');Replace<search_query>with the text you want to search for.
```

75. Use SQL transactions to ensure data integrity when enrolling students in courses or updating theirGPA.

```
-- Enrolling a student in a
courseBEGIN;
```

```
INSERT INTO Course_registration (student_id,
course_id)VALUES(<stuDent_id>,<course_id>);
UPDATEstudent
SET enrolled_courses = enrolled_courses +
1WHERE student_id =
<student_id>;COMMIT;

-- Updating a Student's
GPABEGIN;
UPDATEstudent
SET gpa=<new_gpa>
WHEREstudent_id=<student_id>;
-- Any other related updates should be placed here, e.g., updating class rank,
etc.COMMIT;
```

76. Optimize a slow-running query using indexes, subqueries, or other query optimization techniques.

Here's an example of optimizing a slow-running query that finds students enrolled in a precise course:

Original query:

```
“SELECT *
FROM student
WHERE Student_id
  IN
  (SELECTstudent_id
  FROMcourse_registration
  WHERECourse_id=<specific_course_id>
);”
```

Optimized Query Using JOIN:

```
“SELECT s.*
FROM                                                    StudentASs
```

```
JOIN course_registration AS cr ON s.student_id =
cr.student_idWHEREcr.course_id =<specific_course_id>;”
```

Additionally, you could create an index on course_registration(course_id) andstudent(student_id)to speed up the join operation:

```
“CREATE INDEX idx_course_registration_course_id O N
Course_registration(course_id);

CREASTEINDEXidx_student_id ONstudent(student_id);”
```

77. UseSQL joins to recover a list of students and the course they are registered for.

```
“SELECT s.student_id, s.student_name, c.course_id,
c.course_titleFROM studentASs
JOIN course_registration AS cr ON s.student_id =
cr.student_idJOINcourseAS cONcr.course_id= c.course_id;”
```

78. UseSQLjoinstorecoverarecord ofinstructorsandthecoursetheyareteaching.

```
“SELECT i.instructor_id, i.instructor_name, c.course_id,
c.course_titleFROM instructor AS i
JOINcourseASc ONi.instructor_id= c.instructor_id;”
```

79. UseSQL joins to recover a list of courses and their prerequisites.

```
SELECT c1.course_id AS course_id, c1.course_title AS
    course_title,c2.course_idASprerequisite_id,c2.course_titleASprerequisite_
    title
FROMcourse A Sc1
JOIN course_prerequisite AS cp ON c1.course_id =
cp.course_idJOINcourse A S c2O Ncp.prerequisite_id=
c2.course_id;
```

80. Write down a SQL query to create a normalized schema for an online store, including tables for customers, products, orders, and order items. Ensure each table has appropriate primary and foreign keys.

```
“CREATE TABLE Customers (
  customer_idINTPRIMARYKEYAUTO_INCREMENT,
  first_name VARCHAR(250) NOT NULL,last_name VARCHAR(250) NOT
  NULL,emailVARCHAR(250)UNIQUENOTNULL
);

CREATE TABLE Products (
  Product_idINT  PRIMARYK E YAUTO_INCREMENT,
  product_name VARCHAR(255) NOT NULL,

  PriceDECIMAL(10,2)NOTNULL,
  stock_levelINTNOTNULL
);

CREATE TABLE Orders (
  order_idINT PRIMARYKEY AUTO_INCREMENT,
  customer_id INT NOT NULL,order_date DATE NOT NULL,total_priceDECIMAL( 10
  ,2)NOTNULL,
  FOREIGNKEY(customer_Id)REFERENCES Customers(customer_id)
);
CREATETABLEOrder_Items(
  order_item_id INT PRIMARY KEY AUTO_INCREMENT,order_idINT NOTNULL,
  product_id INT NOT NULL,quantityINTNOTNULL,
  FOREIGN KEY (order_id) REFERENCES
  Orders(order_Id),FOREiGNKEY(product_id)REFERENCESProducts(product_id),)”
```

81. Write down a “SQL query “ to create an index On the product name in the "Products" table,assuming the product name column is called"product_name".

```
CREATE INDEXidx_product_nameONProducts(product_name);
```

82. Write a “SQL query” to find the top 3 Best-selling products in the online store, based on the total quantity sold.

```
“SELECT p.product_id, p.product_name, SUM(oi.quantity) as
total_soldFROMProductsp
```

```
JOIN order_Itemsoi ON p.product_id =
oi.product_idGROUPByp.product_id,p.proDuct_name
ORDER BY total_sold DESCLIMIT 3;”
```

83. Write a “SQL query” to find the total revenue generated by the online store for a given date range,using the"Orders"and "Order_Items"tables.

```
SELECT SUM(o.total_price) as total_revenueFROMOrderso
WHEREo.order_dateBETWEEN start_dateANDend_date;
```

84. Create a stored procedure to insert a new customer record into the "Customers' ' table,checking for duplicate email addresses and returning an appropriate error message if duplicate is found.

```
DELIMITER//
CREATE PROCEDURE InsertCustomer(INp_first_nameVARCHAR(255),
 IN
 p_last_nameVARCHAR(255),INp_emailVARCHAR(255),OUTp_statusVARCHAR(255)
)BEGIN
 DECLAREemail_existsINTDEFAULT0;
 SELECT COUNT(*) INTO email_existsFROMCustomers
 WHERE email=p_email;

 IFemail_exists>0THEN
   SET p_status = 'Error: Email address already exists.';ELSE
   INSERT INTO Customers (First_name, last_name,
   email)VALUES(p_First_name,p_last_name,p_email);
   SET p_status = 'Success: Customer added.';ENDIF;
END//DELIMITER;
```

85. Create a stored procedure to update the stock level meant for a product in the "Products"table,considering the stock level should not be less than zero.

```
DELIMITER//
CREATE PROCEDURE Update STOCK Level(INp_product_idINT,
 INp_STOCK_level INT,
 OUTp_statusVARCHAR(255)
)BEGIN
 IFp_stock_level< 0THEN
   SET p_status = 'Error: Stock level cannot be negative.';ELSE
   UPDATEproducts
   SET stock_level = p_stock_levelWHEREproduct_id=p_product_id;
   SET p_status = 'Success: Stock level
   updated.';ENDIF;

END//DELIMI
TER;
```

86. Write a SQL query to implement a transaction that inserts a new order and its associated order items into the "Orders" and "Order_Items" tables, ensuring data consistency.

```
BEGINTRANSACTION;

--InserttheneworderintotheOrderstable
INSERT INTO Orders (order_id, customer_id,
order_date)VALUES(NEW_ORDER_ID,CUSTOMER_ID,'Y

YYY-MM-DD');

-- Insert the associated order items into the Order_Items table
INSERT INTO Order_Items (order_id, product_id, quantity, price)
VALUES(NEW_ORDER_ID,PRODUCT_ID_1,QUANTITY_1,PR
ICE_1),
    (NEW_ORDER_ID, PRODUCT_ID_2, QUANTITY_2,
    PRICE_2),(NEW_ORDER_ID,PRODUCT_ID_3,QUANTI
    TY_3,PRICE_3);

-- Check for errors and commit the transaction if no errors
occurredIF@@ERROR=0
  COMMIT
TRANSACTION;ELSE
  ROLL BACK TRANSACTION;
```

87. Write a SQL query to Create a view that displays the whole revenue generated by each customer.

```
“CREATE VIEW Customer_RevenueAS
SELECT c.customer_id, c.customer_name, SUM(oi.price * oi.quantity) AS
total_revenue FROM Customersc
JOIN Order so ONc.Customer_id=o.customer_id
JOIN Order_ItemsoI ON o.order_id =
oi.order_idGROUPBYC.customer_id,c.customer_name;”
```

88. Implement a trigger that automatically calculates and updates the total price of an order in the "Orders" table when a new record is inserted into the "Order_Items"table.

```
“CREATE TRIGGER Update_Order_Total AFTER INSERT ON Order_Items
FOR EACH ROWBEGIN
 UPDATEOrders
 SET total_price = total_price + (NEW.quantity * NEW.price)WHERE
 order_id=NEW.order_id;
END;”
```

89. Write a SQL query to create a schema for a many-to-many relationship among students and courses, using a junction table for enrollments.

```
-- Create Students table “CREATE TABLE students (student_id INT
PRIMARY KEY,
 student_nameVARCHAR(255)NOTNULL
);
-- Create Courses tableCREATE TABLE Courses
(course_idINTPRIMARYKEY,
 course_name VARCHAR(255)NOTNULL
);

--CreateEnrollmentsjunction table
```

```
CREATE TABLE Enrollments (student_idINT,
  course_Id INT,enrollment_dateDATE,
  PRIMARYKEY(student_id, course_id),
  FOREIGN KEY (Student_id) REFERENCES Students
  (student_id),FOREIGNKEY(course_id)REFERENCES Courses (course_id)
);”
```

90. Write a SQL query to uncover the average grade of all students in a specific course, using the "Students", "Courses", and"Enrollments"tables.

```
“SELECT AVG(Enrollments.grade) AS  average_grade FROM Students
JOIN Enrollments ON Students.Student_id = Enrollments.student_id JOIN Courses ON
Enrollments.course_id = Courses.course_id WHERE Courses.course_name =
'SpecificCourseName';”
```

91. Write down a SQL query to identify clients who have placed more than 5 orders in the online store,using the "Customers" and "Orders" tables.

```
“SELECT Customers.customer_id, Customers.customer_name FROM Customers
JOIN Orders ON Customers.customer_id = Orders.customer_idGROUP BY
Customers.customer_id, Customers.customer_name HAVING COUNT(Orders.order_id) >
5;
```

92. Write a SQL query to Find the products that have not been ordered in the last 30 days,using the "Products","Orders",and "OrderItems"tables.

```
“SELECT Products.product_id, Products.product_name FROM Products
LEFT JOIN Order_Items ON Products.Product_id =Order_Items.product_id

LEFT JOIN Orders ON Order_Items.order_id=Orders.order_id
WHERE Orders.order_date< CURRENT_DATE - INTERVAL '30 days' OR
Orders.order_id ISNULL
GROUP BY Products.product_id,Products.product_name;”
```

93. Implement a trigger that checks the stock point of a product before inserting a new record into the "Order_Items" table. If the stock level is insufficient, cancel the insertion and return an error message.

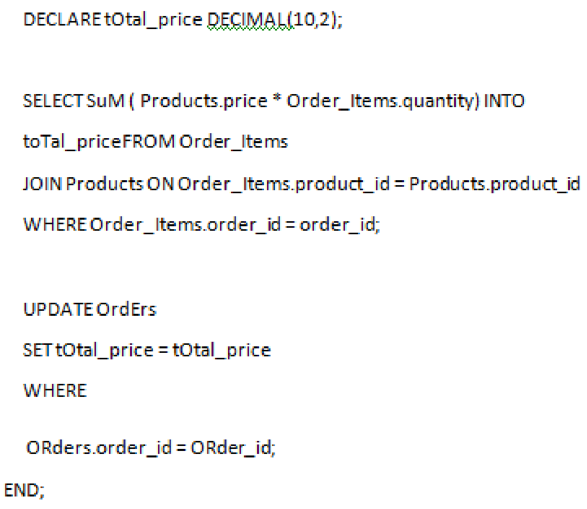
```
“DELIMITER//
CREATE TRIGGER
```

```
check_stock_level BEFORE  INSERT ON Order_Items FOR EACH ROW
BEGIN
   DECLARE stock_level INT;SELECT stock INTO stock_level FROM Products
   WHERE Products.ProdUct_id=NEW.prodUct_id;

   IF stock_level<NEW.quantity THEN
   SIGNAL SQLSTATE 45000'
      SET MESSAGE_TEXT = 'Insufficient stock level.';ENDIF;
END;
//DELIMITER :"
```

94. Create a stored procedure to calculate and update the total price of an order after adding,updating, or deleting an orderitem.

```
CREATE PROCEDURE Update Total Price(IN order_id INT)BEGIN
```



```
  DECLARE tOtal_price DECIMAL(10,2);

  SELECT SuM ( Products.price * Order_Items.quantity) INTO
  toTal_priceFROM Order_Items
  JOIN Products ON Order_Items.product_id = Products.product_id
  WHERE Order_Items.order_id = order_id;

  UPDATE OrdErs
  SET tOtal_price = tOtal_price
  WHERE

   ORders.order_id = ORder_id;
END;
```

95. Write a SQL query to Create an index on the "Orders" table to optimize the search for order placed within a specific date range.

```
CREATE INDEX idx_orders_order_date ON Orders (order_date);
```

96. Write a "SQL query" to find the total number of enrollments for each course, sorted by the number of enrollments in descending order.

```
“SELECT Courses.course_Id, Courses.course_naMe,
COUNT(Enrollments.student_id) asenrollment_count

FROM Courses


JOIN Enrollment ON Courses.course_id = Enrollments.course_id

GROUP BYCourses.course_id,Courses.course_name

ORDER BY enrollment_count DESC;”
```

97. Create a view to display the number of products sold in each product category,using the"Products" and "Order_Items"tables.

```
“CREATE VIEWproducts_sold_by_category AS

SELECT Products.category, COUNT(Order_Items.product_id)asproducts_sold
```

```
FROM Products
JOIN Order_Items ON Products.product_id = Order_Items.product_id GROUP BY
products.category;”
```

98. Implement a Foreign key constraint on the "Enrollments" table to ensure that a record can only be added if the corresponding student and course IDs exist in the "Students" and"Courses"tables.

```
“ALTER TABLE Enrollments
ADD FOREIGN KEY (student_id) REFERENCES
students(student_id),ADDFOREIGNKEY(course_id)
REFERENCE Scourses(course_id);”
```

99. Write a SQL query to identify the top three customers who have spent the most money on top of the online store, based on the total price of their orders.

```
“SELECT Customers.customer_id, customers.customer_name, SUM(Orders.total_price)
astotal_spent
FROM Customers
JOIN Orders ON customers.customer_id = Orders.customer_idGROUP BY
customers.customer_id, Customers.customer_name ORDER BY Total_spent DESC
LIMIT 3;”
```

100. Write down a SQL query to find the students who have taken at least 1 course from each department, using the "Students", "Courses", "Enrollments", and "Departments" tables.Assume there is a "department_id" column in both the "Courses" and "Departments"tables.

To find the students who have taken at least 1 course from each department, you can usethefollowingSQLquery:

```
WITH Department Courses AS(
  SELECT DISTINCT department_id, course_idFROM Courses
),
Student Courses AS(SELECT e.student_id, dc.department_id FROM Enrollments
   JOIN CoursescONe.course_id =c.courSe_id
   JOIN Department CoursesdcONc.course_id=dc.course_id),
Department CountsAS(
   SELECT COUNT(*) AS department_count FROM Departments
),
StudentDepartmentCounts AS(
   SELECT student_id, COUNT(DISTINCT department_id)

   AS student_department_count FROM Student Courses
   GROUPBY Student_id

)
SELECT s.student_id, s.name FROM Students s
JOIN Student Department Counts secONds.Student_id=sdc.student_id
JOIN Department Counts cONsdc.Student_department_count=dc.department_count;
```