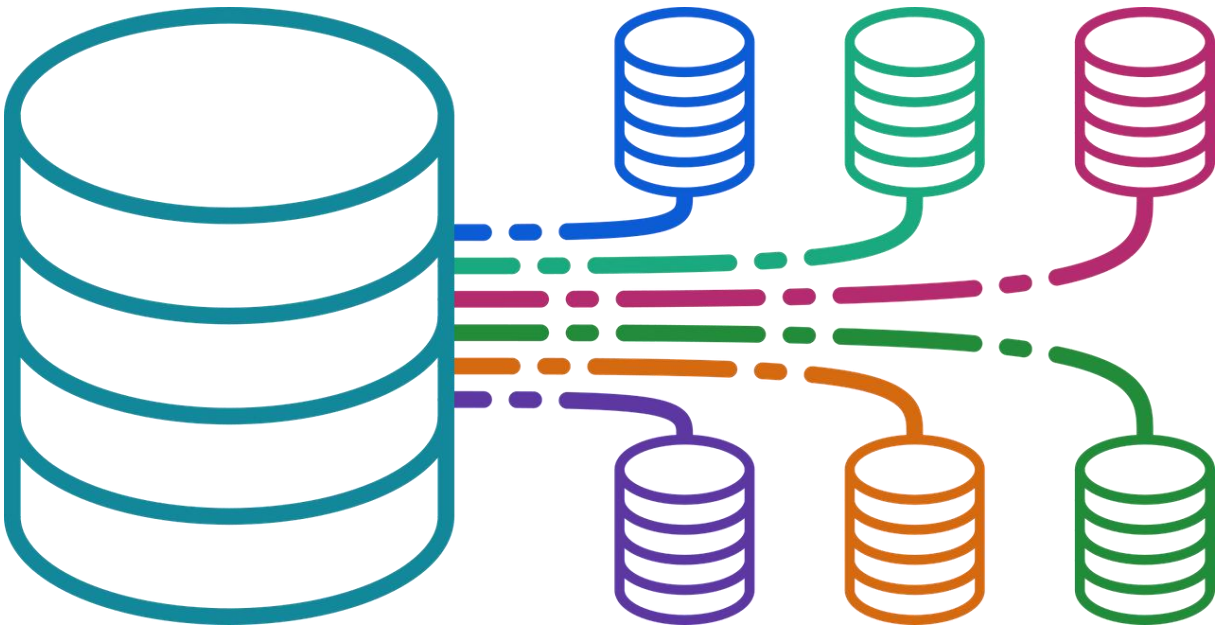
EduNex

DATABASE SYSTEMS

PROJECT REPORT



MALIKA FARID	BCSF21M017
ZAEEM RAZA	BCSF21M022
SYED FARZAND ALI	BCSF21M042

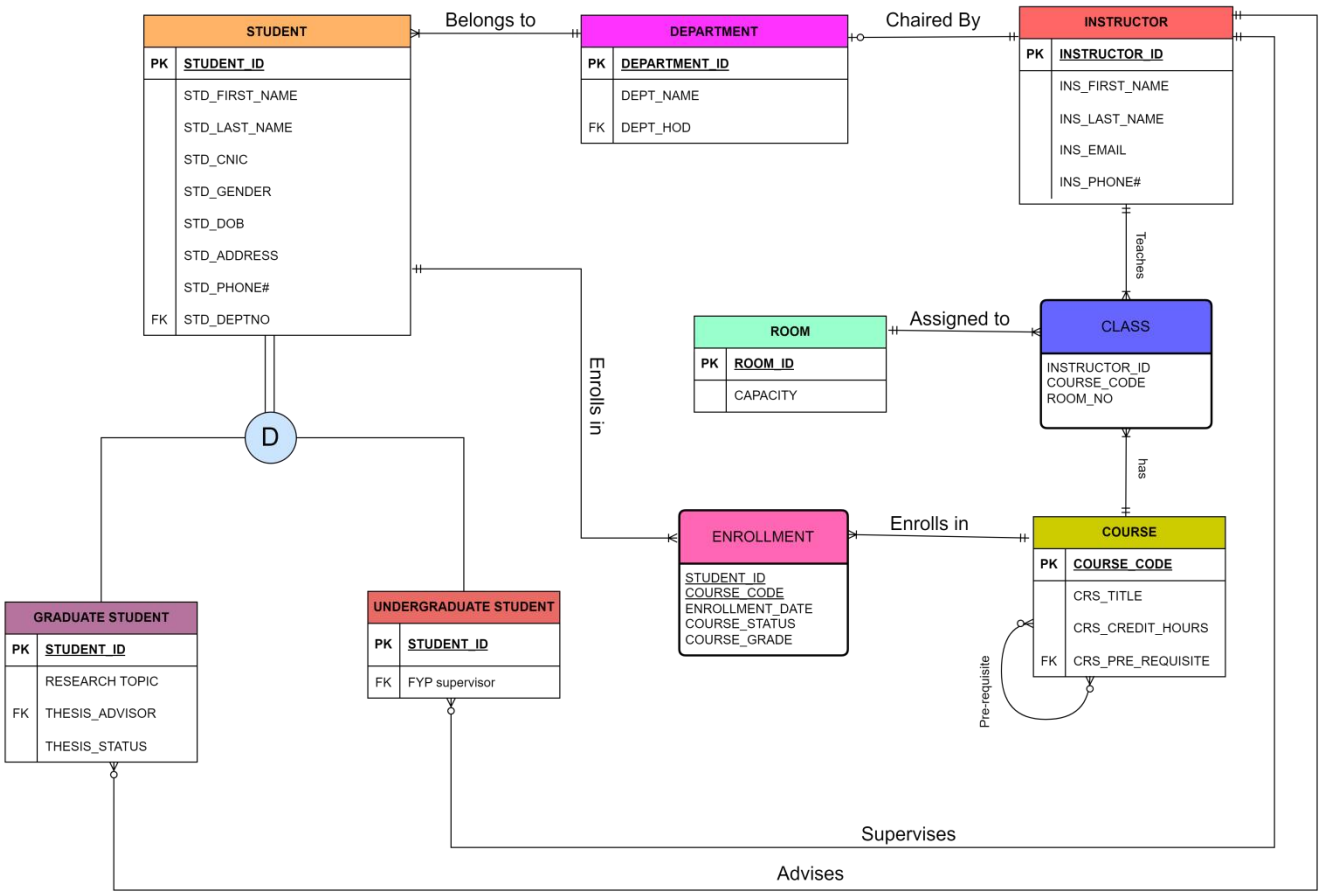
1. Introduction to the working of the system:

A database model has been developed at PUCIT to efficiently manage student records, including information about students, departments, instructors, and courses. This system streamlines operations, supports queries, and ensures future scalability.

2. Problems in the existing system:

PUCIT is transitioning from a manual system to a database management system to streamline operations, reduce effort, and eliminate inconsistencies. The system will efficiently store and manage records for students, departments, and instructors, ensuring seamless query handling and future scalability.

3. Entity - Relation Diagram:



4. ERD Transformation

Student

A strong entity
Student (Student_ID, First_Name, Last_Name, CNIC, Gender, DOB, Address, Phone#, DeptNo)

Graduate Student

Student's Subtype
Graduate Student (Student_ID, Thesis_Advisor_ID, Thesis_Status)

Undergraduate Student

Student's Subtype
Undergraduate Student (Student_ID, FYP_Advisor_ID)

Department

Strong Entity
Department (DeptNo , Dept_Name , Dept_HOD)

Instructor

A regular entity
Instructor (Instructor_ID, First_Name , Last_Name, Email, Phone#)

Room

A regular entity
Room (RoomNo , Capacity)

Course

Recursive relation
Course (Course_Code, Course_Title, Credit_Hours, Pre_Requisite_ID)

Class

An associative entity
Class (Instructor_ID, Course_Code, RoomNo)

Enrollment

An associative entity
Enrollment (Student_ID, Course_Code, Enrollment_Date, Course_Grade, Status)

NOTE:

_____ Indicates primary key
..... Indicates foreign key

5. CONSTRUCTION OF RELATIONAL SCHEMA

- ✧ TOP DOWN APPROACH
- ✧ BOTTOM UP APPROACH

TOP DOWN APPROACH

Identified entities:

- Student
  - Graduate students
  - Undergraduate students
- Instructor
- Department
- Course
- Room
- Class
- Enrollment

Relations:

Student (Student_ID, First_Name, Last_Name, CNIC, Gender, DOB, Address, Phone#, DeptNo)
Graduate Student (Student_ID, Thesis_Advisor_ID, Thesis_Status)
Undergraduate Student (Student_ID, FYP_Advisor_ID)
Department (DeptNo , Dept_Name , Dept_HOD)
Instructor (Instructor_ID, First_Name , Last_Name, Email, Phone#)
Room (RoomNo , Capacity)
Course (Course_Code, Course_Title, Credit_Hours, Pre_Requisite_ID)
Class (Instructor_ID, Course_Code, RoomNo)
Enrollment (Student_ID, Course_Code, Enrollment_Date, Course_Grade, Status)

Normalization

Student (Student_ID, First_Name, Last_Name, CNIC, Gender, DOB, Address, Phone#, DeptNo)
1NF : Already in 1NF as there is no repeating group.
2NF : Already in 2NF as there is no Partial Functional Dependency.
3NF : Already in 3NF as there is no Transitive Dependency.

Graduate Student (Student_ID, Thesis_Advisor_ID, Thesis_Status)
1NF : Already in 1NF as there is no repeating group.
2NF : Already in 2NF as there is no Partial Functional Dependency.
3NF : Already in 3NF as there is no Transitive Dependency.

Undergraduate Student (Student_ID, FYP_Advisor_ID)
1NF : Already in 1NF as there is no repeating group.
2NF : Already in 2NF as there is no Partial Functional Dependency.

3NF : Already in 3NF as there is no Transitive Dependency.

Department (DeptNo , Dept_Name , Dept_HOD)
1NF : Already in 1NF as there is no repeating group.
2NF : Already in 2NF as there is no Partial Functional Dependency.
3NF : Already in 3NF as there is no Transitive Dependency.

Instructor (Instructor_ID, First_Name , Last_Name, Email, Phone#)
1NF : Already in 1NF as there is no repeating group.
2NF : Already in 2NF as there is no Partial Functional Dependency.
3NF : Already in 3NF as there is no Transitive Dependency.

Room (RoomNo , Capacity)
1NF : Already in 1NF as there is no repeating group.
2NF : Already in 2NF as there is no Partial Functional Dependency.
3NF : Already in 3NF as there is no Transitive Dependency.

Course (Course_Code, Course_Title, Credit_Hours, Pre_Requisite_ID)
1NF : A single course can have Multiple pre-requisites. So, there is a repeating group.
Shift the pre-requisite of course to another relation.
After removing repeating group:
Course (Course_Code, Course_Title, Credit_Hours)
Pre_Requisite_Course (Course_Code, Pre_Requisite_ID)
2NF : Already in 2NF as there is no Partial Functional Dependency.
3NF : Already in 3NF as there is no Transitive Dependency.

Class (Instructor_ID, Course_Code, RoomNo)
Normalization:
1NF : Already in 1NF as there is no repeating group.
2NF : Already in 2NF as there is no Partial Functional Dependency.
3NF : Already in 3NF as there is no Transitive Dependency.

Enrollment (Student_ID, Course_Code, Enrollment_Date, Course_Grade, Status)
1NF : Already in 1NF as there is no repeating group.
2NF : Already in 2NF as there is no Partial Functional Dependency.
3NF : Already in 3NF as there is no Transitive Dependency.

Result:

Now all relations are in 3NF, there's no further normalization needed. This indicates that the relations are structured well, with minimal redundancy and efficient data organization.

BOTTOM UP APPROACH

Bulky relation comprising all attributes:

Relation → {Student_ID, Std_First_Name, Std_Last_Name, Std_CNIC, Std_Gender, Std_DOB, Std_Address, Std_Phone#, Std_DeptNo, DeptNo, Dept_Name ,Dept_HOD, Thesis_Advisor_ID, Thesis_Status, FYP_Advisor_ID, Instructor_ID, Ins_First_Name , Ins_Last_Name, Ins_Email, Ins_Phone#, RoomNo , Capacity, Course_Code, Course_Title, Credit_Hours, Pre_Requisite_ID, Enrollment_ID, Enrollment_Date, Course_Grade, Status}

The relation consists of all the attributes in our present ERD. Now, we will construct a sub-relation from above and perform normalization.

Relation

Student(Student_ID,STD_First_name,Last_name,Std_CNIC,Gender,DOB,Address,Phone#,Deptno)

1NF : No repeating Group
2NF : No Partial Functional Dependency
3NF : No Transitive Dependency

Subtypes:

Graduate Student (Student_ID, Thesis_Advisor_ID, Thesis_Status)

*1*NF *:* There is no repeating group
*2*NF *:* Already in 2NF as there is no Partial Functional Dependency.
*3*NF : Already in 3NF as there is no Transitive Dependency.

Undergraduate Student (Student_ID, FYP_Advisor_ID)

*1*NF *:* Already in 1NF as there is no repeating group.
*2*NF *:* Already in 2NF as there is no Partial Functional Dependency.
*3*NF : Already in 3NF as there is no Transitive Dependency.

DEPARTMENT (Deptno,Dept_Name,Dept_HOD)

*1*NF *:* Already in 1NF as there are no multivalued attributes.
*2*NF *:* Already in 2NF as there is no Partial Functional Dependency.
*3*NF : Already in 3NF as there is no Transitive Dependency.

Instructor (Instructor_ID, First_Name , Last_Name, Email, Phone#)

*1*NF *:* Already in 1NF as no duplicating values.
*2*NF *:* Already in 2NF as atomic primary key.
*3*NF : Already in 3NF as no non-key attributes determine other attributes.

Room (RoomNo , Capacity)

*1*NF *:* No duplicate data as there is only one Primary key
*2*NF *:* Already in 2NF as there is no Partial Functional Dependency.
*3*NF : Already in 3NF as there is no Transitive Dependency.

Course (Course_Code, Course_Title, Credit_Hours, Pre_Requisite_ID)
There may be multiple pre-requisite for one course.
So,It does not hold 1NF requirements

After 1NF
Course(Course_Code, Course_Title, Credit_Hours)
Course_Pre_Req (Course_Code, Pre_Requisite_ID)

*2*NF *:* Already in 2NF as there is no Partial Functional Dependency.
*3*NF : Already in 3NF as there is no Transitive Dependency.

Class (Instructor_ID, Course_Code, RoomNo)

*1*NF *:* Already in 1NF as there is no repeating group.
*2*NF *:* Already in 2NF as there is no Partial Functional Dependency.
*3*NF : Already in 3NF as there is no Transitive Dependency.

Enrollment (Student_ID, Course_Code, Enrollment_Date, Course_Grade, Status)

*1*NF *:* Already in 1NF as there is no repeating group.
*2*NF *:* Already in 2NF as there is no Partial Functional Dependency.
*3*NF : Already in 3NF as there is no Transitive Dependency.

Connectivity Table:

Entity	Relationship	Connectivity	Entity
Student	Is a	1:1	Graduate Student
Student	Is a	1:1	Under Graduate Student
Department	Has	1:M	Student
Instructor	Has	1:1	department
Instructor	Has	1:M	Graduate Student
Instructor	Has	1:M	Under graduate student
Student	Has	1:M	Course
Course	Has	1:M	Course
Course	Has	1:M	Student
Room	Has	1:M	Class
Instructor	Has	1:M	Class

6. Description of relations

Student

Attribute	Type	Size	Constraints
STUDENT_ID	CHAR	10	PRIMARY KEY
FIRST_NAME	VARCHAR2	20	NOT NULL
LAST_NAME	VARCHAR2	20	NOT NULL
CNIC	CHAR	13	UNIQUE
GENDER	CHAR	1	M OR F
DOB	DATE		
ADDRESS	VARCHAR2	50	
PHONE#	CHAR	13	NOT NULL , UNIQUE
DEPTNO	NUMBER		REFERENCE TO DEPARTMENT

Graduate Student

Attribute	Type	Size	Constraints
STUDENT_ID	CHAR	10	PRIMARY KEY, REFERENCE TO STUDENT
THESIS_ADVISOR	CHAR	10	REFERENCE TO INSTRUCTOR
THESIS_STATUS	VARCHAR2	20	'COMPLETE' OR 'IN PROGRESS'

Under Graduate Student

Attribute	Type	Size	Constraints
STUDENT_ID	CHAR	10	PRIMARY KEY, REFERENCE TO STUDENT
FYP_ADVISOR	CHAR	10	REFERENCE TO INSTRUCTOR

Department

Attribute	Type	Size	Constraints
DEPTNO	NUMBER		PRIMARY KEY
DEPTNAME	VARCHAR2	50	NOT NULL
HOD	CHAR	10	REFERENCE TO INSTRUCTOR

Instructor

Attribute	Type	Size	Constraints
INSTRUCTOR_ID	CHAR	10	PRIMARY KEY
FIRST_NAME	VARCHAR2	20	NOT NULL
LAST_NAME	VARCHAR2	20	NOT NULL
EMAIL	VARCHAR2	30	UNIQUE
PHONE#	CHAR	13	NOT NULL , UNIQUE

Room

Attribute	Type	Size	Constraints
ROOMNO	NUMBER		PRIMARY KEY
CAPACITY	NUMBER		POSITIVE INTEGER

Course

Attribute	Type	Size	Constraints
COURSE_CODE	VARCHAR2	10	PRIMARY KEY
COURSE_TITLE	VARCHAR2	50	NOT NULL
CREDIT_HOURS	NUMBER		BETWEEN 0.5 AND 3

Pre_Requisite_Course

Attribute	Type	Size	Constraints
COURSE_CODE	VARCHAR2	10	PRIMARY KEY, REFERENCE TO COURSE
PRE_REQ	VARCHAR2	10	PRIMARY KEY, REFERENCE TO COURSE

Class

Attribute	Type	Size	Constraints
INSTRUCTOR_ID	CHAR	10	PRIMARY KEY, REFERENCE TO INSTRUCTOR
COURSE_CODE	VARCHAR2	10	PRIMARY KEY, REFERENCE TO COURSE
ROOM_NO	NUMBER		REFERENCE TO ROOM

Enrollment

Attribute	Type	Size	Constraints
STUDENT_ID	CHAR	10	PRIMARY KEY, REFERENCE TO STUDENT
COURSE_CODE	VARCHAR2	10	PRIMARY KEY,REFERENCE TO COURSE
ENROLLMENT_DATE	DATE		
GRADE	CHAR	1	‘A’,’B’,’C’,’D’ OR F
STATUS	CHAR	4	‘PASS’ OR ‘FAIL’

7. CREATE TABLE statements for all relations

Student

```
CREATE TABLE Student
(
    STUDENT_ID CHAR(10) CONSTRAINT pk_student PRIMARY KEY,
    FIRST_NAME VARCHAR2(20) CONSTRAINT nn_first_name NOT NULL,
    LAST_NAME VARCHAR2(20) CONSTRAINT nn_last_name NOT NULL,
    CNIC CHAR(13) CONSTRAINT uq_cnic UNIQUE,
    GENDER CHAR(1) CONSTRAINT ck_gender CHECK (GENDER IN ('M', 'F')),
    DOB DATE,
    ADDRESS VARCHAR2(50),
    PHONE CHAR(13) CONSTRAINT nn_phone NOT NULL,
    DEPTNO NUMBER CONSTRAINT fk_deptno REFERENCES Department(DEPTNO)
);
```

Table	Column	Data Type	Length	Precision	Scale	Primary Key	Nullable	Default	Comment
STUDENT	STUDENT_ID	CHAR	10	-	-	1	-	-	-
	FIRST_NAME	VARCHAR2	20	-	-	-	-	-	-
	LAST_NAME	VARCHAR2	20	-	-	-	-	-	-
	CNIC	CHAR	13	-	-	-	✓	-	-
	GENDER	CHAR	1	-	-	-	✓	-	-
	DOB	DATE	7	-	-	-	✓	-	-
	ADDRESS	VARCHAR2	50	-	-	-	✓	-	-
	PHONE	CHAR	13	-	-	-	-	-	-
	DEPTNO	NUMBER	22	-	-	-	✓	-	-

Graduate Student

```
CREATE TABLE Graduate_Student
(
    STUDENT_ID CHAR(10) CONSTRAINT pk_graduate_student PRIMARY KEY REFERENCES
Student(STUDENT_ID),
    THESIS_ADVISOR    CHAR(10)    CONSTRAINT    fk_thesis_advisor    REFERENCES
Instructor(INSTRUCTOR_ID),
    THESIS_STATUS    VARCHAR2(20)    CONSTRAINT    ck_thesis_status    CHECK
(THESIS_STATUS IN ('COMPLETE', 'IN PROGRESS'))
);
```

Table	Column	Data Type	Length	Precision	Scale	Primary Key	Nullable	Default	Comment
GRADUATE_STUDENT	STUDENT_ID	CHAR	10	-	-	1	-	-	-
	THESIS_ADVISOR	CHAR	10	-	-	-	✓	-	-
	THESIS_STATUS	VARCHAR2	20	-	-	-	✓	-	-
									1 - 3

Under Graduate Student

```
CREATE TABLE Undergraduate_Student
(
    STUDENT_ID CHAR(10) CONSTRAINT pk_undergraduate_student PRIMARY KEY
REFERENCES Student(STUDENT_ID),
    FYP_ADVISOR CHAR(10) CONSTRAINT fk_fyp_advisor REFERENCES
Instructor(INSTRUCTOR_ID)
);
```

Table	Column	Data Type	Length	Precision	Scale	Primary Key	Nullable	Default	Comment
UNDERGRADUATE_STUDENT	STUDENT_ID	CHAR	10	-	-	1	-	-	-
	FYP_ADVISOR	CHAR	10	-	-	-	✓	-	-

1 - 2

Department

```
CREATE TABLE Department
(
    DEPTNO NUMBER CONSTRAINT pk_department PRIMARY KEY,
    DEPTNAME VARCHAR2(50) CONSTRAINT nn_deptname NOT NULL,
    HOD CHAR(10) CONSTRAINT fk_hod REFERENCES Instructor(INSTRUCTOR_ID)
);
```

Table	Column	Data Type	Length	Precision	Scale	Primary Key	Nullable	Default	Comment
DEPARTMENT	DEPTNO	NUMBER	22	-	-	1	-	-	-
	DEPTNAME	VARCHAR2	50	-	-	-	-	-	-
	HOD	CHAR	10	-	-	-	✓	-	-

1 - 3

Instructor

```
CREATE TABLE Instructor
(
    INSTRUCTOR_ID CHAR(10) CONSTRAINT pk_instructor PRIMARY KEY,
    FIRST_NAME VARCHAR2(20) CONSTRAINT nn_instructor_first_name NOT NULL,
    LAST_NAME VARCHAR2(20) CONSTRAINT nn_instructor_last_name NOT NULL,
    EMAIL VARCHAR2(30) CONSTRAINT uq_instructor_email UNIQUE,
    PHONE CHAR(13) CONSTRAINT nn_instructor_phone NOT NULL
);
```

Table	Column	Data Type	Length	Precision	Scale	Primary Key	Nullable	Default	Comment
INSTRUCTOR	INSTRUCTOR_ID	CHAR	10	-	-	1	-	-	-
	FIRST_NAME	VARCHAR2	20	-	-	-	-	-	-
	LAST_NAME	VARCHAR2	20	-	-	-	-	-	-
	EMAIL	VARCHAR2	30	-	-	-	✓	-	-
	PHONE	CHAR	13	-	-	-	-	-	-

1 - 5

Room

```
CREATE TABLE Room
(
    ROOMNO NUMBER CONSTRAINT pk_room PRIMARY KEY,
    CAPACITY NUMBER CONSTRAINT ck_capacity CHECK (CAPACITY > 0)
);
```

Table	Column	Data Type	Length	Precision	Scale	Primary Key	Nullable	Default	Comment
ROOM	ROOMNO	NUMBER	22	-	-	1	-	-	-
	CAPACITY	NUMBER	22	-	-	-	✓	-	-
									1 - 2

Course

```
CREATE TABLE Course
(
    COURSE_CODE VARCHAR2(10) CONSTRAINT pk_course PRIMARY KEY,
    COURSE_TITLE VARCHAR2(50) CONSTRAINT nn_course_title NOT NULL,
    CREDIT_HOURS NUMBER CONSTRAINT ck_credit_hours CHECK (CREDIT_HOURS BETWEEN
0.5 AND 3)
);
```

Table	Column	Data Type	Length	Precision	Scale	Primary Key	Nullable	Default	Comment
COURSE	COURSE_CODE	VARCHAR2	10	-	-	1	-	-	-
	COURSE_TITLE	VARCHAR2	50	-	-	-	-	-	-
	CREDIT_HOURS	NUMBER	22	-	-	-	✓	-	-
									1 - 3

Pre_Requisite_Course

```
CREATE TABLE Pre_Requisite_Course
(
    COURSE_CODE VARCHAR2(10) CONSTRAINT fk_course_code REFERENCES Course
(COURSE_CODE),
    PRE_REQ VARCHAR2(10) CONSTRAINT fk_pre_req REFERENCES Course (COURSE_CODE),
    CONSTRAINT pk_pre_requisite_course PRIMARY KEY (COURSE_CODE, PRE_REQ)
);
```

Table	Column	Data Type	Length	Precision	Scale	Primary Key	Nullable	Default	Comment
PRE_REQUISITE_COURSE	COURSE_CODE	VARCHAR2	10	-	-	1	-	-	-
	PRE_REQ	VARCHAR2	10	-	-	2	-	-	-
									1 - 2

Class

```
CREATE TABLE Class
(
    INSTRUCTOR_ID CHAR (10) CONSTRAINT fk_class_instructor REFERENCES
Instructor (INSTRUCTOR_ID),
    COURSE_CODE VARCHAR2(10) CONSTRAINT fk_class_course REFERENCES Course
(COURSE_CODE),
    ROOM_NO NUMBER CONSTRAINT fk_class_room REFERENCES Room(ROOMNO),
    CONSTRAINT pk_class PRIMARY KEY (INSTRUCTOR_ID, COURSE_CODE)
);
```

Table	Column	Data Type	Length	Precision	Scale	Primary Key	Nullable	Default	Comment
CLASS	INSTRUCTOR_ID	CHAR	10	-	-	1	-	-	-
	COURSE_CODE	VARCHAR2	10	-	-	2	-	-	-
	ROOM_NO	NUMBER	22	-	-	-	✓	-	-
									1 - 3

Enrollment

```
CREATE TABLE Enrollment
(
    STUDENT_ID CHAR(10) CONSTRAINT fk_enrollment_student REFERENCES
Student(STUDENT_ID),
    COURSE_CODE VARCHAR2(10) CONSTRAINT fk_enrollment_course REFERENCES
Course(COURSE_CODE),
    ENROLLMENT_DATE DATE,
    GRADE CHAR(1) CONSTRAINT ck_grade CHECK (GRADE IN ('A', 'B', 'C', 'D',
'F')),
    STATUS CHAR(4) CONSTRAINT ck_status CHECK (STATUS IN ('PASS', 'FAIL')),
    CONSTRAINT pk_enrollment PRIMARY KEY (STUDENT_ID, COURSE_CODE)
);
```

Table	Column	Data Type	Length	Precision	Scale	Primary Key	Nullable	Default	Comment
ENROLLMENT	STUDENT_ID	CHAR	10	-	-	1	-	-	-
	COURSE_CODE	VARCHAR2	10	-	-	2	-	-	-
	ENROLLMENT_DATE	DATE	7	-	-	-	✓	-	-
	GRADE	CHAR	1	-	-	-	✓	-	-
	STATUS	CHAR	4	-	-	-	✓	-	-
									1 - 5

8. Views of relational schema

1. Student Details:

```
CREATE OR REPLACE VIEW student_details AS
SELECT
    S.STUDENT_ID,
    S.FIRST_NAME || ' ' || S.LAST_NAME AS FULL_NAME,
    S.CNIC,
    S.GENDER,
    S.DOB,
    S.ADDRESS,
    S.PHONE,
    D.DEPTNAME AS DEPARTMENT_NAME,
    H.FIRST_NAME || ' ' || H.LAST_NAME AS DEPARTMENT_HEAD
FROM
    Student S
JOIN Department D ON S.DEPTNO = D.DEPTNO
JOIN Instructor H ON D.HOD = H.INSTRUCTOR_ID;

select * from student_details
```

2. Enrollment Details

```
CREATE VIEW Enrollment_Details AS
SELECT
    e.STUDENT_ID,
    s.FIRST_NAME,
    s.LAST_NAME,
    e.COURSE_CODE,
    c.COURSE_TITLE,
    e.ENROLLMENT_DATE,
    e.GRADE,
    e.STATUS
FROM Enrollment e
JOIN Student s ON e.STUDENT_ID = s.STUDENT_ID
JOIN Course c ON e.COURSE_CODE = c.COURSE_CODE

select * from enrollment_details
```

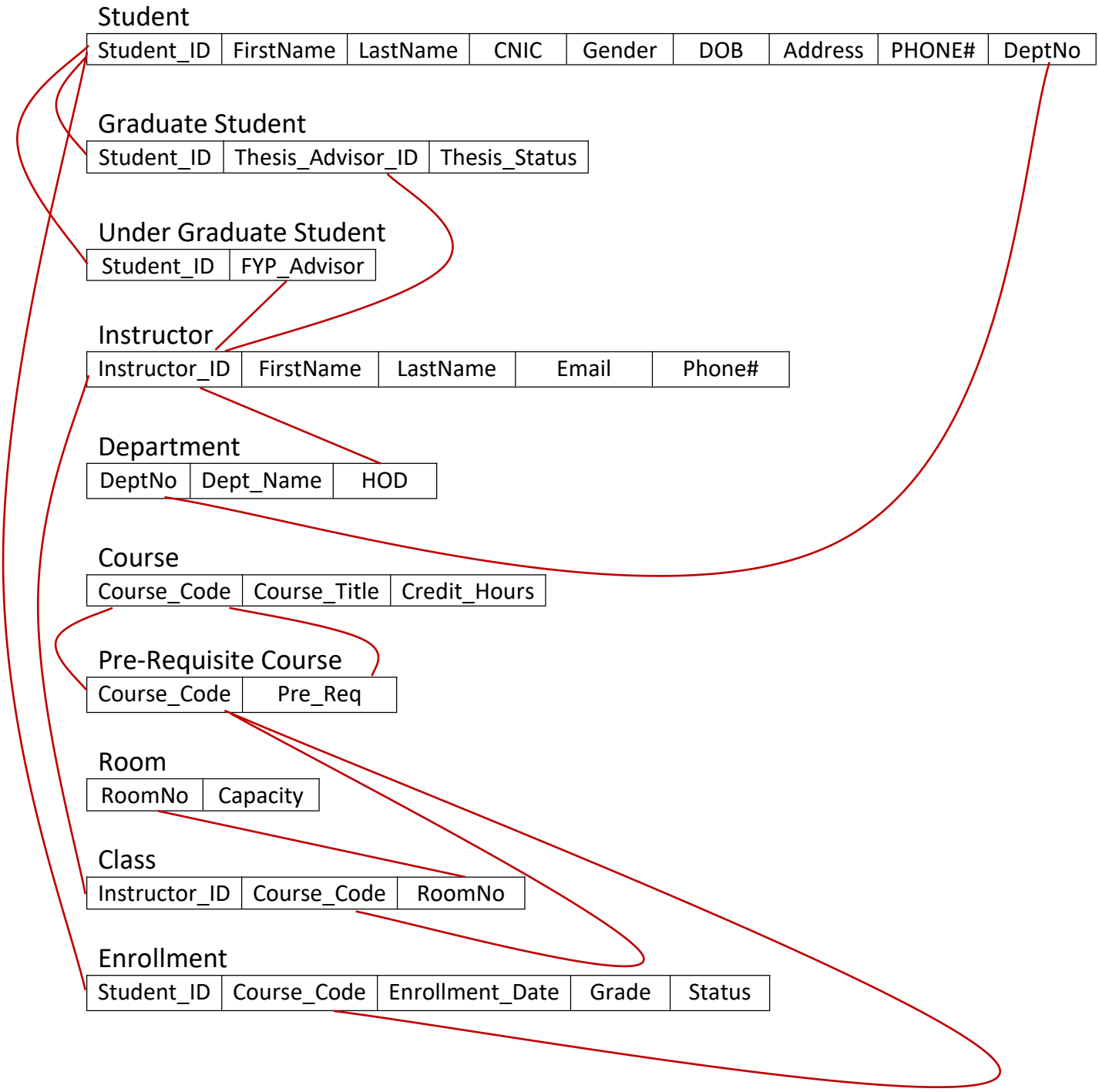
3. Graduate Students Details:

```
CREATE OR REPLACE VIEW Graduate_Student_Details AS
SELECT
    gs.STUDENT_ID,
    CONCAT(s.FIRST_NAME,CONCAT(' ',s.LAST_NAME)) "STUDENT NAME",
    s.CNIC,
    s.GENDER,
    s.DOB,
    s.ADDRESS,
    s.PHONE,
    CONCAT(i.FIRST_NAME,CONCAT(' ',i.LAST_NAME)) "ÄDVISOR NAME",
    gs.THESIS_STATUS
FROM Graduate_Student gs
JOIN Student s ON gs.STUDENT_ID = s.STUDENT_ID
JOIN Instructor i ON gs.THESIS_ADVISOR = i.INSTRUCTOR_ID;
```

4. Pre-Requisite Courses Details:

```
CREATE OR REPLACE VIEW Pre_Requisite_Course_Details AS
SELECT
    c.COURSE_TITLE AS COURSE_TITLE,
    prc2.COURSE_TITLE AS PRE_REQ_TITLE
FROM Pre_Requisite_Course prc
JOIN Course c ON prc.COURSE_CODE = c.COURSE_CODE
JOIN Course prc2 ON prc.PRE_REQ = prc2.COURSE_CODE;
```

9. Relational Data Model showing associations



10. Five Common Reports

1. QUERY TO RETRIEVE STUDENTS WHOSE THESIS IS COMPLETE

```
SELECT  S.FIRST_NAME||'  '||S.LAST_NAME  AS  NAME,  I.FIRST_NAME||'
'||I.LAST_NAME ADVISOR,G.THESIS_STATUS
FROM STUDENT S
JOIN GRADUATE_STUDENT G ON G.STUDENT_ID =S.STUDENT_ID
JOIN INSTRUCTOR I ON I.INSTRUCTOR_ID=G.THESIS_ADVISOR
WHERE G.THESIS_STATUS='COMPLETE'
```

2. QUERY TO RETRIEVE ROOMS THAT ARE FREE YET

```
SELECT R.ROOMNO,R.CAPACITY
FROM ROOM R
LEFT JOIN CLASS C ON R.ROOMNO = C.ROOM_NO
WHERE
C.ROOM_NO IS NULL
```

3. QUERY TO RETRIEVE DEPARTMENT ID ,NAME ,HEAD AND NUMBER OF STUDENTS IN THAT DEPARTMENT

```
SELECT
    d.DEPTNO,
    d.DEPTNAME,
    i.FIRST_NAME || ' ' || i.LAST_NAME AS HEAD_NAME,
    COUNT(s.STUDENT_ID) AS STUDENT_COUNT
FROM Department d
JOIN Instructor i ON d.HOD = i.INSTRUCTOR_ID
LEFT JOIN Student s ON d.DEPTNO = s.DEPTNO
GROUP BY d.DEPTNO, d.DEPTNAME, i.FIRST_NAME, i.LAST_NAME;
```

4. LIST INSTRUCTORS WHO ARE SUPERVISING AN FYP

```
SELECT
DISTINCT I.INSTRUCTOR_ID,CONCAT(I.FIRST_NAME,CONCAT(' ',I.LAST_NAME))
AS NAME
FROM Instructor I
JOIN Undergraduate_Student U ON I.INSTRUCTOR_ID = U.FYP_ADVISOR;
```

5. STUDENT WHO ARE FAILED IN ANY SUBJECT

```
SELECT
S.STUDENT_ID,S.FIRST_NAME||'    '    ||    S.LAST_NAME    AS    NAME,
C.COURSE_TITLE,I.FIRST_NAME||' '||I.LAST_NAME AS TEACHER_NAME
FROM STUDENT S
JOIN ENROLLMENT E ON S.STUDENT_ID = E.STUDENT_ID
JOIN COURSE C ON C.COURSE_CODE = E.COURSE_CODE
JOIN CLASS CL ON  E.COURSE_CODE=CL.COURSE_CODE
JOIN INSTRUCTOR I ON I.INSTRUCTOR_ID = CL.INSTRUCTOR_ID
WHERE GRADE ='F'
```

11. Procedures

1. PROCEDURE TO SHOW THE RESULT OF SPECIFIC STUDENT

```
CREATE OR REPLACE PROCEDURE Student_Result(
    p_STUDENT_ID CHAR
) IS
    CURSOR c_Enrollments IS
        SELECT e.COURSE_CODE, c.COURSE_TITLE, e.GRADE, e.STATUS
        FROM Enrollment e
        JOIN Course c ON e.COURSE_CODE = c.COURSE_CODE
        WHERE e.STUDENT_ID = p_STUDENT_ID;

    v_COURSE_CODE VARCHAR2(10);
    v_COURSE_TITLE VARCHAR2(50);
    v_GRADE CHAR(1);
    v_STATUS CHAR(4);
BEGIN
    OPEN c_Enrollments;
    LOOP
        FETCH  c_Enrollments  INTO  v_COURSE_CODE,  v_COURSE_TITLE,
v_GRADE, v_STATUS;
        EXIT WHEN c_Enrollments%NOTFOUND;
        DBMS_OUTPUT.PUT_LINE('Course Code: ' || v_COURSE_CODE);
        DBMS_OUTPUT.PUT_LINE('Course Title: ' || v_COURSE_TITLE);
        DBMS_OUTPUT.PUT_LINE('Grade: ' || v_GRADE);
        DBMS_OUTPUT.PUT_LINE('Status: ' || v_STATUS);
        DBMS_OUTPUT.PUT_LINE('-----------------------------');
    END LOOP;
    CLOSE c_Enrollments;
EXCEPTION
    WHEN NO_DATA_FOUND THEN
        DBMS_OUTPUT.PUT_LINE('No  enrollments  found  for  the  given
Student ID.');
    WHEN TOO_MANY_ROWS THEN
        DBMS_OUTPUT.PUT_LINE('Too many rows returned');
END;
/
```

2. Procedure to Insert a student

```
CREATE OR REPLACE PROCEDURE InsertStudent(
    p_STUDENT_ID CHAR,
    p_FIRST_NAME VARCHAR2,
    p_LAST_NAME VARCHAR2,
    p_CNIC CHAR,
    p_GENDER CHAR,
    p_DOB DATE,
    p_ADDRESS VARCHAR2,
    p_PHONE CHAR,
    p_DEPTNO NUMBER
) IS
BEGIN
    INSERT INTO Student (STUDENT_ID,FIRST_NAME,LAST_NAME,CNIC,
        GENDER,DOB,ADDRESS,PHONE,DEPTNO) VALUES
(p_STUDENT_ID, p_FIRST_NAME,p_LAST_NAME,p_CNIC,p_GENDER, p_DOB,
 p_ADDRESS,p_PHONE,p_DEPTNO);
EXCEPTION
    WHEN NO_DATA_FOUND THEN
        DBMS_OUTPUT.PUT_LINE('No data found.');
    WHEN TOO_MANY_ROWS THEN
        DBMS_OUTPUT.PUT_LINE('Too many Rows');
END;
/
```

3. PROCEDURE TO INSERT A RECORD IN ENROLLMENT TABLE AND CALCULATING GRADE BY MARKS

```
CREATE OR REPLACE PROCEDURE InsertGrade
(
    p_student_id IN CHAR,
    p_course_id IN VARCHAR2,
    p_marks IN NUMBER
) AS
    v_grade CHAR(1);
    v_status CHAR(4);
BEGIN

    IF p_marks > 85 THEN
        v_grade := 'A';
        v_status := 'PASS';
    ELSIF p_marks > 75 THEN
        v_grade := 'B';
        v_status := 'PASS';
    ELSIF p_marks > 65 THEN
```

```
        v_grade := 'C';
        v_status := 'PASS';
    ELSIF p_marks > 50 THEN
        v_grade := 'D';
        v_status := 'PASS';
    ELSE
        v_grade := 'F';
        v_status := 'FAIL';
    END IF;
    INSERT INTO Enrollment (STUDENT_ID, COURSE_CODE, ENROLLMENT_DATE,
GRADE, STATUS)
    VALUES (p_student_id, p_course_id, SYSDATE, v_grade, v_status);
EXCEPTION
    WHEN NO_DATA_FOUND THEN
        DBMS_OUTPUT.PUT_LINE('No data found');
    WHEN TOO_MANY_ROWS THEN
        DBMS_OUTPUT.PUT_LINE('Too many rows');
END;
/
```

12. Functions

1. FUNCTION TO GET AVERAGE GRADE POINT IN A COURSE

```
CREATE OR REPLACE FUNCTION GetAVGGradePoint (
    p_course_code IN VARCHAR2
) RETURN NUMBER IS
    v_average_grade NUMBER;
BEGIN
    SELECT AVG(CASE
                   WHEN GRADE = 'A' THEN 4.0
                   WHEN GRADE = 'B' THEN 3.0
                   WHEN GRADE = 'C' THEN 2.0
                   WHEN GRADE = 'D' THEN 1.0
                   WHEN GRADE = 'F' THEN 0.0
               END)
    INTO v_average_grade
    FROM Enrollment
    WHERE COURSE_CODE = p_course_code;

    RETURN v_average_grade;
EXCEPTION
    WHEN NO_DATA_FOUND THEN
        RETURN NULL;
END;
/
```

2. FUNCTION TO GET NUMBER OF COURSES BEING TAUGT BY A SPECIFIC INSTRUCTOR

```
CREATE OR REPLACE FUNCTION GetClassCountForTeacher (
    p_instructor_id IN CHAR
) RETURN NUMBER IS
    v_class_count NUMBER;
BEGIN
    SELECT COUNT(*)
    INTO v_class_count
    FROM Class
    WHERE INSTRUCTOR_ID = p_instructor_id;

    RETURN v_class_count;
EXCEPTION
    WHEN NO_DATA_FOUND THEN
        RETURN 0;
    WHEN OTHERS THEN
        RETURN -1;
END;
/
```

3. FUNCTION TO COUNT THE NUMBER OF GRADUATE STUDENTS IN A DEPARTMENT

```
CREATE OR REPLACE FUNCTION GetTotalGraduateStudentsInDept (
    p_deptno IN NUMBER
) RETURN NUMBER IS
    v_student_count NUMBER;
BEGIN
    SELECT COUNT(*)
    INTO v_student_count
    FROM Graduate_Student gs
    JOIN Student s ON gs.STUDENT_ID = s.STUDENT_ID
    WHERE s.DEPTNO = p_deptno;

    RETURN v_student_count;
EXCEPTION
    WHEN NO_DATA_FOUND THEN
        RETURN 0;
    WHEN OTHERS THEN
        RETURN -1;
END;
/
```

13. Triggers

Trigger that no more than 20 students are enrolled in a course

```
CREATE OR REPLACE TRIGGER trg_CheckCourseEnrollmentLimit
BEFORE INSERT ON Enrollment
FOR EACH ROW
DECLARE
    v_enrolled_students NUMBER;
BEGIN
    SELECT COUNT(*)
    INTO v_enrolled_students
    FROM Enrollment
    WHERE COURSE_CODE = :NEW.COURSE_CODE;
        IF v_enrolled_students >= 20 THEN
        RAISE_APPLICATION_ERROR(-20001, 'Enrollment limit exceeded
for this course. No more than 20 students can be enrolled.');
    END IF;
END;
/
```

Trigger to check if student has passed pre req

```
CREATE OR REPLACE TRIGGER trg_EnforcePrereqCompletion
BEFORE INSERT ON Enrollment
FOR EACH ROW
DECLARE
    v_prereq_completed NUMBER;
BEGIN

    SELECT COUNT(*)
    INTO v_prereq_completed
    FROM Enrollment e
    JOIN Pre_Requisite_Course p ON e.COURSE_CODE = p.PRE_REQ
    WHERE e.STUDENT_ID = :NEW.STUDENT_ID
    AND p.COURSE_CODE = :NEW.COURSE_CODE
    AND e.STATUS = 'PASS';

    IF v_prereq_completed = 0 THEN
        RAISE_APPLICATION_ERROR(-20002, 'Prerequisite courses not
completed.');
    END IF;
END;
/
```