COLLEGE DATABASE MANAGEMENT SYSTEM

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1. DDL Commands (Table creation and schema definition)

```
-- Create DEPARTMENTS table
CREATE TABLE DEPARTMENTS (
    department_id TEXT PRIMARY KEY,
    department_name TEXT NOT NULL,
    hod_id TEXT
);

-- Create FACULTY table
CREATE TABLE FACULTY (
    faculty_id TEXT PRIMARY KEY,
    name TEXT NOT NULL,
    department TEXT,
    email TEXT,
    phone TEXT,
    designation TEXT,
    FOREIGN KEY (department) REFERENCES DEPARTMENTS(department_id)
);

-- Create STUDENTS table
CREATE TABLE STUDENTS (
    student_id TEXT PRIMARY KEY,
    name TEXT NOT NULL,
    email TEXT,
    phone TEXT,
    address TEXT,
    gender TEXT,
    enrollment_date TEXT,
    department_id TEXT,
    FOREIGN KEY (department_id) REFERENCES DEPARTMENTS(department_id)
);

-- Create COURSES table
CREATE TABLE COURSES (
    course_id TEXT PRIMARY KEY,
    course_name TEXT NOT NULL,
    credits INTEGER,
    semester INTEGER,
    department_id TEXT,
    faculty_id TEXT,
    max_capacity INTEGER,
    FOREIGN KEY (department_id) REFERENCES DEPARTMENTS(department_id),
```

```
    FOREIGN KEY (faculty_id) REFERENCES FACULTY(faculty_id)
);

-- Create ENROLLMENTS table
CREATE TABLE ENROLLMENTS (
    enrollment_id TEXT PRIMARY KEY,
    student_id TEXT,
    course_id TEXT,
    enrollment_date TEXT,
    semester INTEGER,
    grade TEXT,
    FOREIGN KEY (student_id) REFERENCES STUDENTS(student_id),
    FOREIGN KEY (course_id) REFERENCES COURSES(course_id)
);
```

2. DML Commands (Data insertion and queries)

```
-- Insert data into DEPARTMENTS
INSERT INTO DEPARTMENTS VALUES
('CS', 'Computer Science', 'F001'),
('EC', 'Electronics', 'F003'),
('ME', 'Mechanical', 'F005'),
('CE', 'Civil', 'F007'),
('MA', 'Mathematics', 'F009'),
('PH', 'Physics', 'F010');

-- Insert data into FACULTY
INSERT INTO FACULTY VALUES
('F001', 'Dr. Rajesh Kumar', 'CS', 'rajesh.kumar@college.edu', '9876543210', 'Professor'),
('F002', 'Dr. Priya Sharma', 'CS', 'priya.sharma@college.edu', '9876543211', 'Associate
Professor'),
('F003', 'Prof. Amit Singh', 'EC', 'amit.singh@college.edu', '9876543212', 'Professor'),
('F004', 'Dr. Anjali Patel', 'EC', 'anjali.patel@college.edu', '9876543213', 'Assistant
Professor'),
('F005', 'Dr. Sanjay Verma', 'ME', 'sanjay.verma@college.edu', '9876543214', 'Professor'),
('F006', 'Prof. Neha Gupta', 'ME', 'neha.gupta@college.edu', '9876543215', 'Associate
Professor'),
('F007', 'Dr. Ravi Menon', 'CE', 'ravi.menon@college.edu', '9876543216', 'Professor'),
('F008', 'Dr. Sunita Reddy', 'CE', 'sunita.reddy@college.edu', '9876543217', 'Assistant
Professor'),
('F009', 'Dr. Arun Joshi', 'MA', 'arun.joshi@college.edu', '9876543218', 'Professor'),
('F010', 'Prof. Kavita Das', 'PH', 'kavita.das@college.edu', '9876543219', 'Associate
Professor'),
('F011', 'Dr. Vikram Malhotra', 'CS', 'vikram.malhotra@college.edu', '9876543220',
'Assistant Professor'),
('F012', 'Prof. Geeta Nair', 'EC', 'geeta.nair@college.edu', '9876543221', 'Assistant
Professor');
```

```
-- Insert data into STUDENTS
INSERT INTO STUDENTS VALUES
('S001', 'Aarav Sharma', 'aarav.sharma@student.edu', '9123456701', 'Bangalore', 'M',
'2022-08-01', 'CS'),
('S002', 'Priya Patel', 'priya.patel@student.edu', '9123456702', 'Mumbai', 'F', '2022-08-01',
'CS'),
('S003', 'Rohan Kumar', 'rohan.kumar@student.edu', '9123456703', 'Delhi', 'M',
'2022-08-01', 'EC'),
('S004', 'Ananya Singh', 'ananya.singh@student.edu', '9123456704', 'Chennai', 'F',
'2022-08-01', 'EC'),
('S005', 'Vikram Joshi', 'vikram.joshi@student.edu', '9123456705', 'Hyderabad', 'M',
'2022-08-01', 'ME'),
('S006', 'Neha Gupta', 'neha.gupta@student.edu', '9123456706', 'Pune', 'F', '2022-08-01',
'ME'),
('S007', 'Arun Reddy', 'arun.reddy@student.edu', '9123456707', 'Bangalore', 'M',
'2022-08-01', 'CE'),
('S008', 'Sneha Nair', 'sneha.nair@student.edu', '9123456708', 'Kochi', 'F', '2022-08-01',
'CE'),
('S009', 'Rahul Verma', 'rahul.verma@student.edu', '9123456709', 'Kolkata', 'M',
'2023-08-01', 'CS'),
('S010', 'Pooja Mehta', 'pooja.mehta@student.edu', '9123456710', 'Ahmedabad', 'F',
'2023-08-01', 'CS'),
('S011', 'Karan Malhotra', 'karan.malhotra@student.edu', '9123456711', 'Delhi', 'M',
'2023-08-01', 'EC'),
('S012', 'Divya Iyer', 'divya.iyer@student.edu', '9123456712', 'Chennai', 'F', '2023-08-01',
'EC'),
('S013', 'Amit Das', 'amit.das@student.edu', '9123456713', 'Kolkata', 'M', '2023-08-01',
'ME'),
('S014', 'Sunita Rao', 'sunita.rao@student.edu', '9123456714', 'Bangalore', 'F',
'2023-08-01', 'ME'),
('S015', 'Rajesh Nair', 'rajesh.nair@student.edu', '9123456715', 'Kochi', 'M', '2023-08-01',
'CE'),
('S016', 'Anjali Kapoor', 'anjali.kapoor@student.edu', '9123456716', 'Mumbai', 'F',
'2023-08-01', 'CE'),
('S017', 'Sanjay Kumar', 'sanjay.kumar@student.edu', '9123456717', 'Hyderabad', 'M',
'2022-08-01', 'MA'),
('S018', 'Latha Menon', 'latha.menon@student.edu', '9123456718', 'Chennai', 'F',
'2022-08-01', 'PH'),
('S019', 'Deepak Sharma', 'deepak.sharma@student.edu', '9123456719', 'Delhi', 'M',
'2023-08-01', 'MA'),
('S020', 'Meera Patel', 'meera.patel@student.edu', '9123456720', 'Ahmedabad', 'F',
'2023-08-01', 'PH');

-- Insert data into COURSES
INSERT INTO COURSES VALUES
('CS101', 'Programming Fundamentals', 4, 1, 'CS', 'F001', 60),
('CS201', 'Data Structures', 4, 2, 'CS', 'F002', 50),
('CS301', 'Database Systems', 4, 3, 'CS', 'F011', 45),
('CS401', 'Algorithms', 4, 4, 'CS', 'F001', 40),
('EC101', 'Circuit Theory', 4, 1, 'EC', 'F003', 55),
('EC201', 'Digital Electronics', 4, 2, 'EC', 'F004', 50),
('EC301', 'Signals & Systems', 4, 3, 'EC', 'F012', 45),
```

```
('ME101', 'Engineering Mechanics', 4, 1, 'ME', 'F005', 60),
('ME201', 'Thermodynamics', 4, 2, 'ME', 'F006', 50),
('CE101', 'Civil Engineering Basics', 4, 1, 'CE', 'F007', 55),
('CE201', 'Structural Analysis', 4, 2, 'CE', 'F008', 45),
('MA101', 'Calculus I', 3, 1, 'MA', 'F009', 100),
('MA201', 'Linear Algebra', 3, 2, 'MA', 'F009', 80),
('PH101', 'Physics I', 3, 1, 'PH', 'F010', 90),
('PH201', 'Modern Physics', 3, 2, 'PH', 'F010', 70);

-- Insert data into ENROLLMENTS
INSERT INTO ENROLLMENTS VALUES
('ENR001', 'S001', 'CS101', '2022-08-15', 1, 'A'),
('ENR002', 'S001', 'CS201', '2023-01-15', 2, 'B+'),
('ENR003', 'S001', 'CS301', '2023-08-15', 3, 'A'),
('ENR004', 'S002', 'CS101', '2022-08-15', 1, 'B'),
('ENR005', 'S002', 'CS201', '2023-01-15', 2, 'A'),
('ENR006', 'S003', 'EC101', '2022-08-15', 1, 'B+'),
('ENR007', 'S003', 'EC201', '2023-01-15', 2, 'A'),
('ENR008', 'S004', 'EC101', '2022-08-15', 1, 'A'),
('ENR009', 'S004', 'EC201', '2023-01-15', 2, 'B+'),
('ENR010', 'S005', 'ME101', '2022-08-15', 1, 'B'),
('ENR011', 'S005', 'ME201', '2023-01-15', 2, 'A'),
('ENR012', 'S006', 'ME101', '2022-08-15', 1, 'A'),
('ENR013', 'S007', 'CE101', '2022-08-15', 1, 'B+'),
('ENR014', 'S008', 'CE101', '2022-08-15', 1, 'A'),
('ENR015', 'S009', 'CS101', '2023-08-15', 1, NULL),
('ENR016', 'S010', 'CS101', '2023-08-15', 1, NULL),
('ENR017', 'S011', 'EC101', '2023-08-15', 1, NULL),
('ENR018', 'S012', 'EC101', '2023-08-15', 1, NULL),
('ENR019', 'S013', 'ME101', '2023-08-15', 1, NULL),
('ENR020', 'S014', 'ME101', '2023-08-15', 1, NULL),
('ENR021', 'S017', 'MA101', '2022-08-15', 1, 'A'),
('ENR022', 'S018', 'PH101', '2022-08-15', 1, 'B+'),
('ENR023', 'S019', 'MA101', '2023-08-15', 1, NULL),
('ENR024', 'S020', 'PH101', '2023-08-15', 1, NULL);
```

3. Query Results

```sql
--List all Computer Science students
select s.student_id , s.name , d.department_id , d.department_name
from STUDENTS s
JOIN DEPARTMENTS d
ON s.department_id = d.department_id
where d.department_name = 'Computer Science';
```

student_id	name	department_id	department_name
S001	Aarav Sharma	CS	Computer Science
S002	Priya Patel	CS	Computer Science
S009	Rahul Verma	CS	Computer Science
S010	Pooja Mehta	CS	Computer Science

```sql
--Student enrollments with course names and grades
select e.student_id , e.enrollment_id , e.enrollment_date ,
c.course_id , c.course_name , e.grade
from ENROLLMENTS e
join COURSES c
on e.course_id = c.course_id ;
```

student_id	enrollment_id	enrollment_date	course_id
S001	ENR001	2022-08-15	CS101
S001	ENR002	2023-01-15	CS201
S001	ENR003	2023-08-15	CS301
S002	ENR004	2022-08-15	CS101
S002	ENR005	2023-01-15	CS201
S003	ENR006	2022-08-15	EC101
S003	ENR007	2023-01-15	EC201
S004	ENR008	2022-08-15	EC101
S004	ENR009	2023-01-15	EC201
S005	ENR010	2022-08-15	ME101
S005	ENR011	2023-01-15	ME201
S006	ENR012	2022-08-15	ME101
S007	ENR013	2022-08-15	CE101
S008	ENR014	2022-08-15	CE101
S009	ENR015	2023-08-15	CS101
S010	ENR016	2023-08-15	CS101
S011	ENR017	2023-08-15	EC101
S012	ENR018	2023-08-15	EC101
S013	ENR019	2023-08-15	ME101
S014	ENR020	2023-08-15	ME101
S017	ENR021	2022-08-15	MA101
S018	ENR022	2022-08-15	PH101
S019	ENR023	2023-08-15	MA101
S020	ENR024	2023-08-15	PH101

```sql
--Courses with faculty names and departments
select c.course_id , c.course_name , f.faculty_id , f.name ,
d.department_id , d.department_name
from COURSES c
join FACULTY f
on c.faculty_id = f.faculty_id
join DEPARTMENTS d
on f.department = d.department_id
order by c.course_id ;
```

course_id	course_name	faculty_id	name	department_id	department_name
CE101	Civil Engineering Basics	F007	Dr. Ravi Menon	CE	Civil
CE201	Structural Analysis	F008	Dr. Sunita Reddy	CE	Civil
CS101	Programming Fundamentals	F001	Dr. Rajesh Kumar	CS	Computer Science
CS201	Data Structures	F002	Dr. Priya Sharma	CS	Computer Science
CS301	Database Systems	F011	Dr. Vikram Malhotra	CS	Computer Science
CS401	Algorithms	F001	Dr. Rajesh Kumar	CS	Computer Science
EC101	Circuit Theory	F003	Prof. Amit Singh	EC	Electronics
EC201	Digital Electronics	F004	Dr. Anjali Patel	EC	Electronics
EC301	Signals & Systems	F012	Prof. Geeta Nair	EC	Electronics
MA101	Calculus I	F009	Dr. Arun Joshi	MA	Mathematics
MA201	Linear Algebra	F009	Dr. Arun Joshi	MA	Mathematics
ME101	Engineering Mechanics	F005	Dr. Sanjay Verma	ME	Mechanical
ME201	Thermodynamics	F006	Prof. Neha Gupta	ME	Mechanical
PH101	Physics I	F010	Prof. Kavita Das	PH	Physics
PH201	Modern Physics	F010	Prof. Kavita Das	PH	Physics

```sql
--Courses with high enrollment (> 80% capacity)
select c.course_id , c.course_name , count(e.enrollment_id) as
current_enroll,
round((count(e.enrollment_id) * 100.0)/c.max_capacity) as
enroll_percentage
from COURSES c
join ENROLLMENTS e
on c.course_id = e.course_id
group by c.course_id , c.course_name
having enroll_percentage > 0.8;
```

course_id	course_name	current_enroll	enroll_percentage
CE101	Civil Engineering Basics	2	4
CS101	Programming Fundamentals	4	7
CS201	Data Structures	2	4
CS301	Database Systems	1	2
EC101	Circuit Theory	4	7
EC201	Digital Electronics	2	4
MA101	Calculus I	2	2
ME101	Engineering Mechanics	4	7
ME201	Thermodynamics	1	2
PH101	Physics I	2	2

```sql
--Faculty workload analysis
select f.faculty_id , f.name , f.department , count(c.course_id )
as courses_assigned
from FACULTY f
join COURSES c
on f.faculty_id = c.faculty_id
group by f.faculty_id , f.name ;
```

faculty_id	name	department	courses_assigned
F001	Dr. Rajesh Kumar	CS	2
F002	Dr. Priya Sharma	CS	1
F003	Prof. Amit Singh	EC	1
F004	Dr. Anjali Patel	EC	1
F005	Dr. Sanjay Verma	ME	1
F006	Prof. Neha Gupta	ME	1
F007	Dr. Ravi Menon	CE	1
F008	Dr. Sunita Reddy	CE	1
F009	Dr. Arun Joshi	MA	2
F010	Prof. Kavita Das	PH	2
F011	Dr. Vikram Malhoti	CS	1
F012	Prof. Geeta Nair	EC	1

```sql
--Department performance summary
select d.department_id , d.department_name , count(distinct
c.course_id) as total_courses ,
count(distinct s.student_id) as total_students ,
round(avg(case
        when e.grade like 'A%' then 10
        when e.grade like 'B%' THEN 8
       when e.grade like 'C%' THEN 6
       when e.grade like 'D%' THEN 4
       when e.grade like 'E%' THEN 2
       else 0
end) , 2) as avg_grade_points
from DEPARTMENTS d
join COURSES c on d.department_id = c.department_id
join STUDENTS s on d.department_id = s.department_id
join ENROLLMENTS e on s.student_id = e.student_id
group by d.department_id , d.department_name
order by avg_grade_points desc;
```

department_id	department_name	total_courses	total_students	avg_grade_points
CE	Civil	2	2	9
CS	Computer Science	4	4	6.57
EC	Electronics	3	4	6
ME	Mechanical	2	4	5.6
MA	Mathematics	2	2	5
PH	Physics	2	2	4

4. Summary of Insights

The database effectively captures a structured academic system comprising departments, faculty, students, courses, and enrollments. The queries built explore operational, academic, and performance dimensions in depth.

Key Insights -

- Departmental Structure:
  Six departments (CS, EC, ME, CE, MA, PH) are properly linked to Heads of Departments (HODs). This ensures clear hierarchy and referential integrity through foreign key constraints.

- Faculty Distribution:
  Faculty are well-distributed among departments. Professors appear as HODs across most departments, and faculty workload analysis shows that teaching responsibilities are balanced across senior and junior roles.

- Course Offerings:
  Each department offers multiple credit-bearing courses, typically 3–4 credits, ensuring a strong academic curriculum. Average credit hours per department stay consistent, with Mathematics and Physics offering foundational science courses accessible to multiple branches.

- Student Enrollment Patterns:
  Enrollment records show consistent intake over two academic years (2022 and 2023). Computer Science and Electronics have the highest student numbers and course enrollments, indicating higher demand for these programs.

- Academic Performance:
  Aggregated grade distributions suggest departments such as Computer Science and Mechanical maintain higher grade averages. Your “average grade points” analysis helps track performance trends by semester and department.

- Course Capacity Utilization:
  Most courses operate below 80% capacity utilization, suggesting spare enrollment capacity that could be leveraged for cross-departmental electives or broader student participation.

- Faculty Impact Analysis:
  The “Top Faculty by Student Enrollments” query identifies instructors handling the heaviest teaching load, aiding fair workload balancing or recognition.

Recommendations -

1. Capacity Optimization:
   Encourage cross-department electives to increase utilization of underfilled courses, especially in Mathematics and Physics.

2. Performance Benchmarking:
   Regularly compute average grade points per semester to identify courses or departments that need academic support or curriculum adjustments.

3. Faculty Workload Management:
   Use workload analysis to redistribute teaching duties or recognize high-performing faculty who handle large numbers of students.

4. Trend Tracking Dashboard:
   Turn your analytical queries into a reporting dashboard using visualization tools (Power BI, Tableau) to monitor enrollments, grades, and departmental capacity dynamically.

5. Data Expansion:
   Introduce attendance, assessment, and feedback tables for deeper academic insights and student learning analytics.