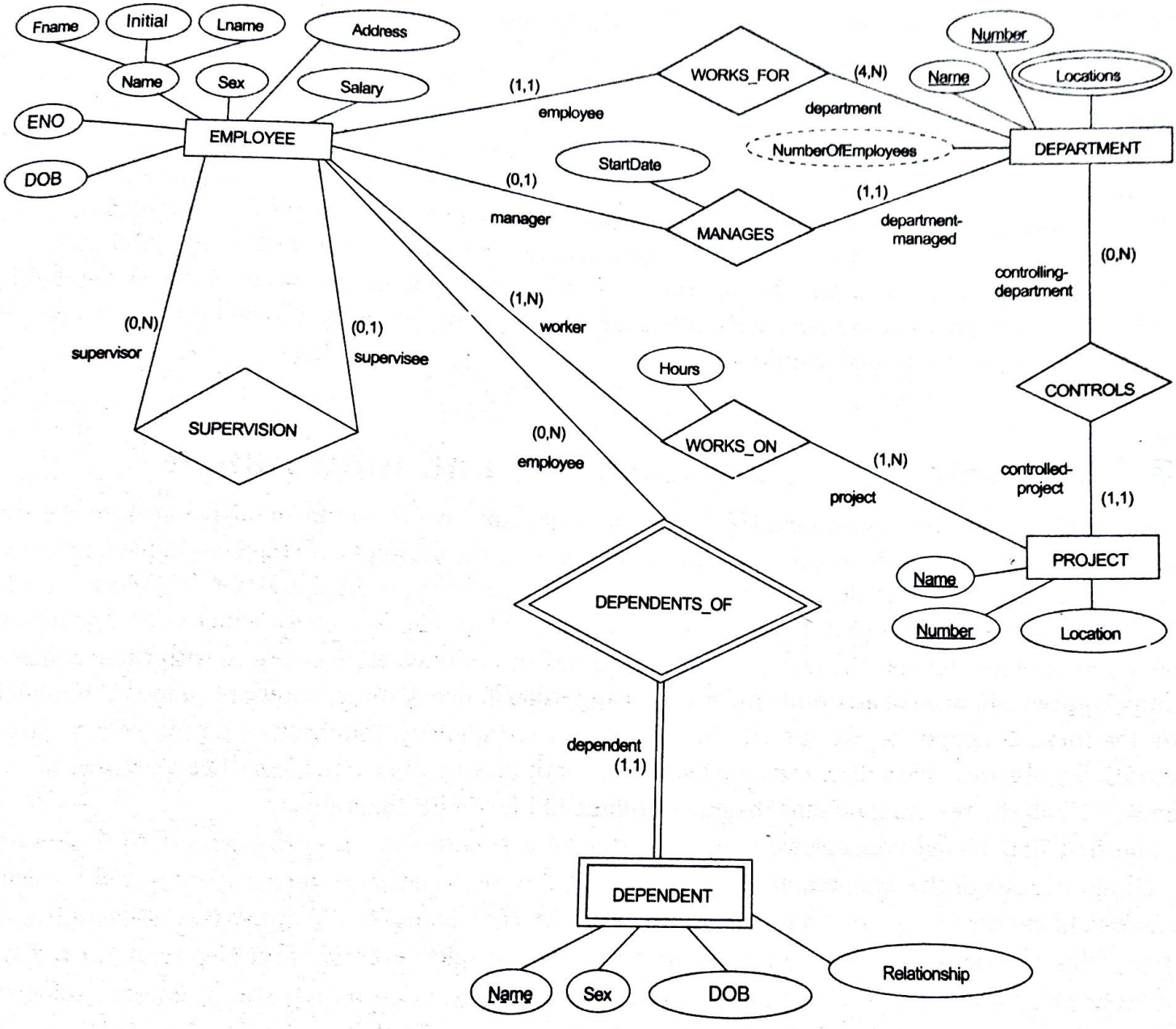

FIGURE 3.15 ER diagrams for the COMPANY schema, with structural constraints specified using (min, max) notation.

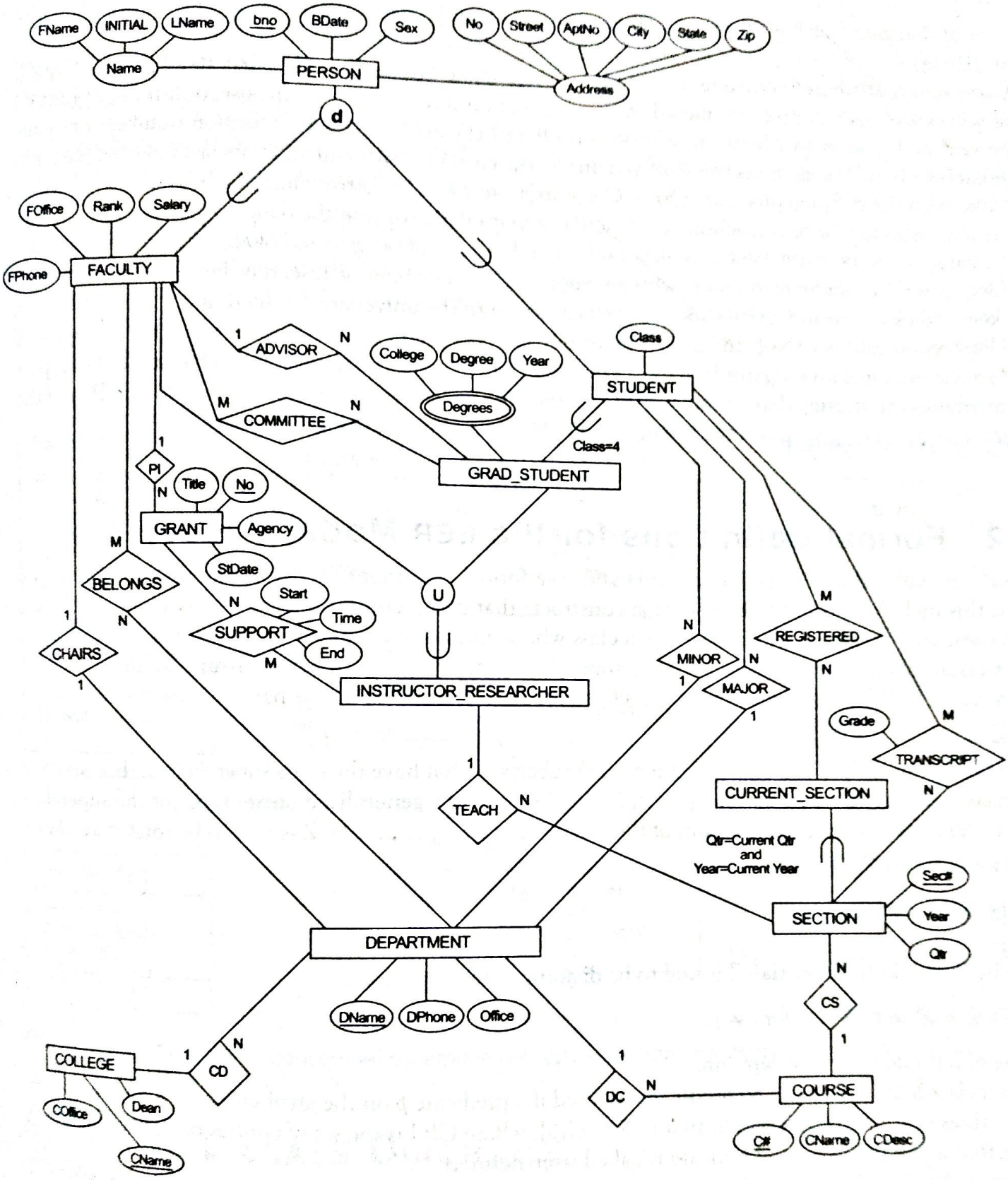

FIGURE 3.24 An EER conceptual schema for a UNIVERSITY database.

GRAD_STUDENT is a subclass of ... with predicate Class = 4. For each graduate student,

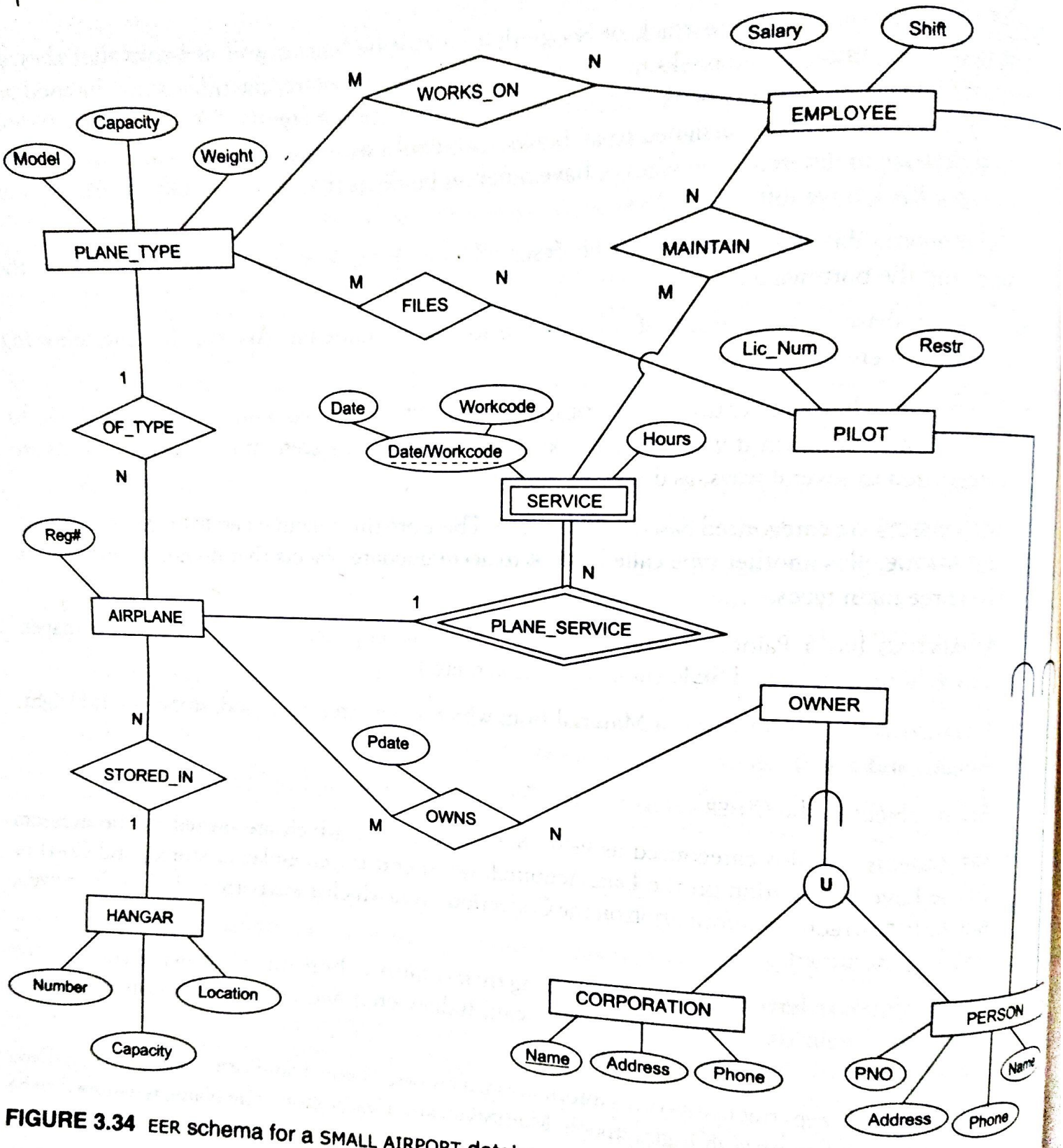

FIGURE 3.34 EER schema for a SMALL AIRPORT database.

TYPE has a model number [Model], a capacity [Capacity], and a weight [Weight]. Each HANGAR has a number [Number], a capacity [Capacity], and a location [Location]. The database also keeps track of the OWNERs of each plane [OWNS] and the EMPLOYEEs who have maintained the plane [MAINTAIN]. Each relationship instance in OWNS relates an airplane to an owner and includes the purchase date [Pdate]. Each relationship instance in MAINTAIN relates an employee to a service record [SERVICE]. Each plane undergoes service many times; hence, it is related [illegible] service records. A service record [illegible]

catalog, and the borrowing activity. ... of the members, the books, the

3.43. Design a database to keep track of information for an art museum. Assume that the following requirements were collected:

- The museum has a collection of ART_OBJECTs. Each ART_OBJECT has a unique IdNo, an Artist (if known), a Year (when it was created, if known), a Title, and a Description. The art objects are categorized in several ways, as discussed below.
- ART_OBJECTs are categorized based on their type. There are three main types: PAINTING, SCULPTURE, and STATUE, plus another type called OTHER to accommodate objects that do not fall into one of the three main types.
- A PAINTING has a PaintType (oil, watercolor, etc.), material on which it is DrawnOn (paper, canvas, wood, etc.), and Style (modern, abstract, etc.).
- A SCULPTURE or a STATUE has a Material from which it was created (wood, stone, etc.), Height, Weight, and Style.
- An art object in the OTHER category has a Type (print, photo, etc.) and Style.
- ART_OBJECTs are also categorized as PERMANENT_COLLECTION, which are owned by the museum (these have information on the DateAcquired, whether it is OnDisplay or stored, and Cost) or BORROWED, which has information on the Collection (from which it was borrowed), DateBorrowed, and DateReturned.
- ART_OBJECTs also have information describing their country/culture using information on country/culture of Origin (Italian, Egyptian, American, Indian, etc.) and Epoch (Renaissance, Modern, Ancient, etc.).
- The museum keeps track of ARTIST's information, if known: Name, DateBorn (if known), DateDied (if not living), CountryOfOrigin, Epoch, MainStyle, and Description. The Name is assumed to be unique.
- Different EXHIBITIONs occur, each having a Name, StartDate, and EndDate. EXHIBITIONs are related to all the art objects that were on display during the exhibition.
- Information is kept on other COLLECTIONs with which the museum interacts, including Name (unique), Type (museum, personal, etc.), Description, Address, Phone, and current ContactPerson.

3.44. Draw an EER schema diagram for this application. Discuss any assumptions you made, and that justify your EER design choices.

Figure 3.34 shows an example of ... keep track of ... data ... used to

prerequisites of each course.

STUDENT	Name	StudentNumber	Class	Major
	Uday	17	1	CS
	Nitin	8	2	CS

COURSE	CourseName	CourseNumber	CreditHours	Department
	Intro to Computer Science	CS1310	4	CS
	Data Structures	CS3320	4	CS
	Discrete Mathematics	MATH2410	3	MATH
	Database	CS3380	3	CS

SECTION	SectionIdentifier	CourseNumber	Semester	Year	Instructor
	85	MATH2410	First	98	Jain
	92	CS1310	First	98	Rao
	102	CS3320	Second	99	Ramesh
	112	MATH2410	First	99	Ravinder
	119	CS1310	First	99	Rao
	135	CS3380	First	99	Srinivas

GRADE_REPORT	StudentNumber	SectionIdentifier	Grade
	17	112	B
	17	119	C
	8	85	A
	8	92	A
	8	102	B
	8	135	A

PREREQUISITE	CourseNumber	PrerequisiteNumber
	CS3380	CS3320
	CS3380	MATH2410
	CS3320	CS1310

FIGURE 1.2 A database that stores student and course information.

2. We use the term file informally here. At a conceptual level, a file is a collection of records that may or may

7.22. Specify the following queries in SQL on the database schema of Figure 1.2.

a. Retrieve the names of all senior students majoring in 'CS' (computer science).
b. Retrieve the names of all courses taught by Professor Jain in 1998 and 1999.
c. For each section taught by Professor Jain, retrieve the course number, semester, year, and number of students who took the section.
d. Retrieve the name and transcript of each senior student (Class = 5) majoring in CS. A transcript includes course name, course number, credit hours, semester, year, and grade for each course completed by the student.
e. Retrieve the names and major departments of all straight-A students (students who have a grade of A in all their courses).
f. Retrieve the names and major departments of all students who do not have a grade of A in any of their courses.

7.23. W

7.23. Write SQL update statements to do the following on the database schema shown in Figure 1.2.

a. Insert a new student, <'Johnson', 25, 1, 'MATH'>, in the database.
b. Change the class of student 'Uday' to 2.
c. Insert a new course, <'Knowledge Engineering', 'CS4390', 3, 'CS'>.
d. Delete the record for the student whose name is 'Uday' and whose student number is 17.

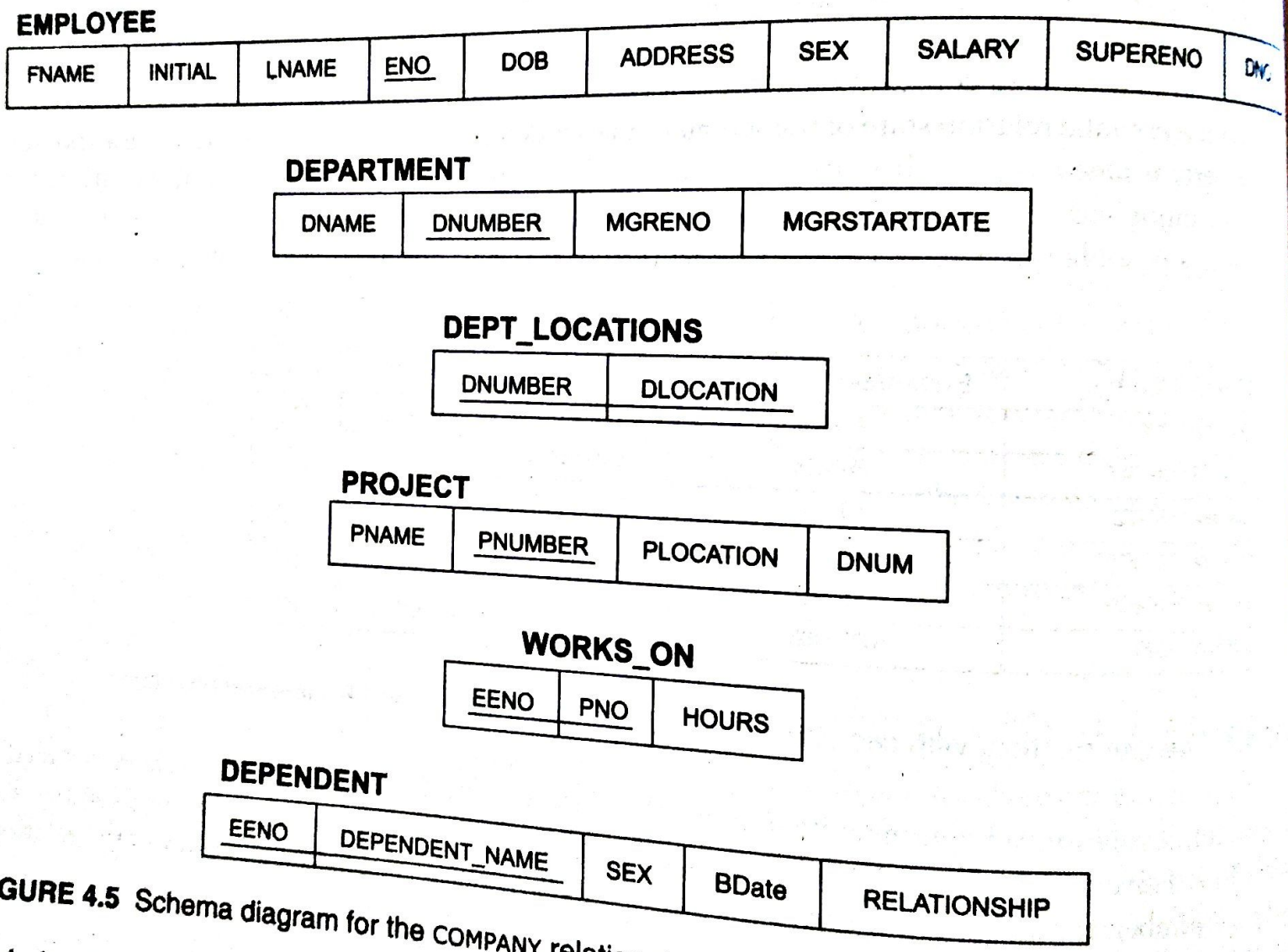

FIGURE 4.5 Schema diagram for the COMPANY relational database schema.

underlined attributes represent primary key
the COMPANY schem

7.32. Repeat Exercise 7.27, but write a function [illegible]

7.33. Repeat Exercise 7.27, but write a function [illegible]

7.34. Specify the following views in SQL on the COMPANY database schema shown in Figure 4.5.

a. A view that has the department name, manager name, and manager salary for every department.

b. A view that has the employee name, supervisor name, and employee salary for each employee who works in the 'Research' department.

c. A view that has the project name, controlling department name, number of employees, and total hours worked per week on the project for each project.

d. A view that has the project name, controlling department name, number of employees, and total hours worked per week on the project for each project *with more than one employee working on it.*

7.35. Consider the following view, DEPT_SUMMARY, defined on the COMPANY database of Figure 4.6:

[illegible] AS (D, C, TOTAL_S, AVERAGE_S)

EMPLOYEE

FNAME	INITIAL	LNAME	ENO	BDATE	ADDRESS	SEX	SALARY	SUPERENO	DNO
Mahesh	B	Kumar	123456789	09-01-1965	731, Ameerpet, Hyderapad, AP	M	30000	333445555	5
Karthik	T	Chandra	333445555	08-12-1955	638, Begampet, Hyderabad, AP	M	40000	888665555	5
Swetha	J	Narayan	999887777	19-01-1968	3321, Hauzkhar, New Delhi	F	25000	987654321	4
Priya	S	Ganesh	987654321	20-06-1941	291, Majestic Street, Bangalore	F	43000	888665555	4
Ramesh	K	Narayan	666884444	15-09-1962	975 Hauzkhas, New Delhi	M	38000	333445555	5
Kiran	A	Goyal	453453453	31-07-1972	5631 Abids, Hyderabad, AP	F	25000	333445555	5
Kikndra	V	Nath	987987987	29-03-1963	980, Koti, Hyderabad, AP	M	25000	987654321	4
Gaurav	E	Kishan	888665555	10-11-1937	450 Abids, Hyderabad, AP	M	55000	null	1

DEPT_LOCATIONS

DNUMBER	DLOCATION
1	Hyderabad
4	Chennai
5	Bangalore
5	New Delhi
	Hyderabad

DEPARTMENT

DNAME	DNUMBER	MGRENO	MGRSTARTDATE
Research	5	333445555	1988-05-22
Administration	4	987654321	1995-01-01
Headquarters	1	888665555	1981-06-19

WORKS_ON

EENO	PNO	HOURS
123456789	1	32.5
123456789	2	7.5
666884444	3	40.0
453453453	1	20.0
453453453	2	20.0
333445555	2	10.0
333445555	3	10.0
333445555	10	10.0
333445555	20	10.0
999887777	30	30.0
999887777	10	10.0
987987987	10	35.0
987987987	30	5.0
987654321	30	20.0
987654321	20	15.0
888665555	20	null

PROJECT

PNAME	PNUMBER	PLOCATION	DNUM
ProductX	1	Bangalore	5
ProductY	2	New Delhi	5
ProductZ	3	Hyderabad	5
Computerization	10	Chennai	4
Reorganization	20	Hyderabad	1
Newbenefits	30	Chennai	4

DEPENDENT

EENO	DEPENDENT_NAME	SEX	BDATE	RELATIONSHIP
333445555	Archana	F	05-04-1986	DAUGHTER
333445555	Tejpaul	M	25-10-1983	SON
333445555	Jyothi	F	03-05-1958	SPOUSE
987654321	Anand	M	28-02-1942	SPOUSE
123456789	Manikam	M	04-01-1988	SON
123456789	Arpitha	F	30-12-1988	DAUGHTER
123456789	Pratyusa	F	05-05-1967	SPOUSE

FIGURE 4.6 One possible database state for the COMPANY relational database schema.

4.2.4 ... and Foreign

7.20. Specify the following additional queries on the database of Figure 4.5 in SQL. Show the query results if each query is applied to the database of Figure 4.6.

a. For each department whose average employee salary is more than Rs. 30,000, retrieve the department name and the number of employees working for that department.

b. Suppose that we want the number of *male* employees in each department rather than all employees (as in Exercise 7.20a). Can we specify this query in SQL? Why or why not?

hours worked ... project with more than one employee working on it.

7.35 Consider the following view, DEPT_SUMMARY, defined on the COMPANY database of Figure 4.6:

```
CREATE VIEW   DEPT_SUMMARY (D, C, TOTAL_S, AVERAGE_S)
AS SELECT     DNO, COUNT (*), SUM (SALARY), AVG (SALARY)
              FROM EMPLOYEE
              GROUP BY DNO;
```

State which of the following queries and updates would be allowed on the view. If a query or update would be allowed, show what the corresponding query or update on the base relations would look like, and give its result when applied to the database of Figure 4.6.

a.
```
SELECT   *
FROM     DEPT_SUMMARY;
```

b.
```
SELECT   D, C
FROM     DEPT_SUMMARY
WHERE    TOTAL_S > 100000;
```

c.
```
SELECT   D, AVERAGE_S
FROM     DEPT_SUMMARY
WHERE    C > (SELECT C FROM DEPT_SUMMARY WHERE D=4);
```

d.
```
UPDATE   DEPT_SUMMARY
SET      D=3
WHERE    D=4;
```

e.
```
DELETE   FROM DEPT_SUMMARY
WHERE    C > 4;
```