UCS1412:Database Lab
Assignment 9A: Database Design using Normal Forms
-Srinithyee S K 185001166

Question) Consider the following relation Company with the set of functional dependencies:
COMPANY(empid, name, address, bdate, sex, salary, dno, dname, mgr_id, pno, pname, pdno, hrs)
fd1: empid -> name, address, bdate, sex, salary, dno
fd2: dno -> dname, mgr_id
fd3: pno -> pname, pdno where pdno is the department controlling the project.
fd4: empid, pno -> hrs
Identify the primary key. Given the FD, key attributes now decompose the Company relation into various Normal forms.
To prove that the decomposition is correct: apply the two properties
a) The lossless-join decomposition.
b) Preservation of FD.

Answer: -

To find Primary Key:-

Let us use the Closure Property
R={empid,name,address,bdate,sex,salary,dno,dname,mdr_id,pno,pname,pdno,hrs}

a)Removing {empid}
$R1^+$={name,address,bdate,sex,salary,dno,dname,mgr_id,pno,pname,pdno,hrs}
Since we cannot derive R from R-{empid},i.e R $\neq R1^+$
we cannot remove empid

b)Removing {name}
R1=R-{name}
$R1^+$=R(from empid -> name fd)
Similarly,we can get R-{ name,address,bdate,sex,salary,dno} since empid determines all theset attributes,using fd1

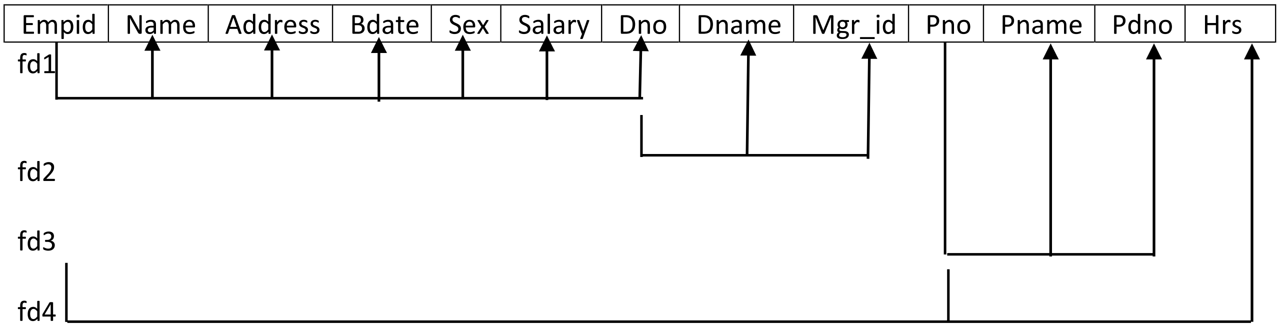
c)Removing {dname} from R1
$R1^+$={ empid,name,address,bdate,sex,salary,dno,pname,pdno,hrs} (from fd1)
$R1^+$={ empid,name,address,bdate,sex,salary,dno,dname,mdr_id,pno,pname,pdno,hrs} (from dno ->dname,mgr_id)
Similarly removing dependents of fd2 as well
R1={empid,pno,pdname,pdno,hrs}

d)Removing {pno}
$R1^+$={empid,name,address,bdate,sex,salary,dno,dname,mgr_id} (from fd1 and fd2)
R $\neq R1^+$
we cannot remove pno

e)Keeping pno and remaining other attributes that are dependents of pno,we get
R1={empid,pno,hrs}
from fd4 however,we can remove hrs because empid,pno ->hrs

WE GET THAT THE PRIMARY KEYS ARE {empid,pno}

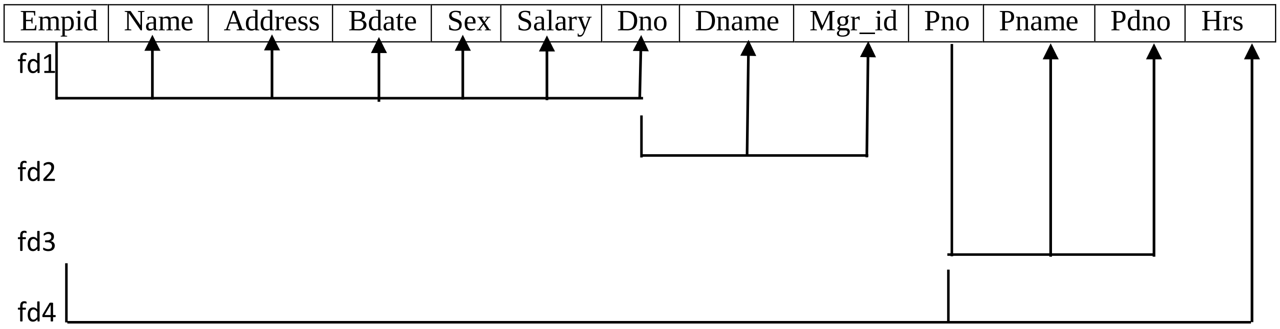
COMPANY TABLE



NORMALISATION

1)1st NORMAL FORM : THERE ARE NO COMPOSITE OR MULTIVALUED ATTRIBUTES.

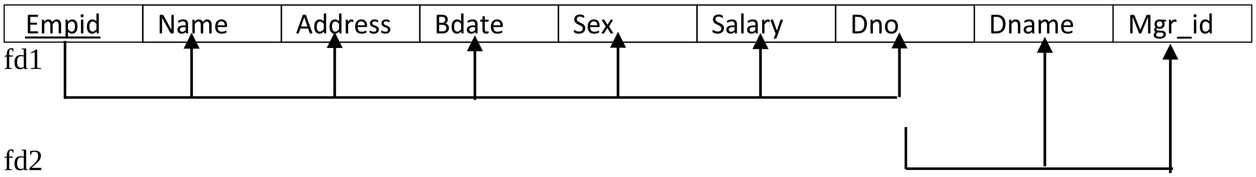
COMPANY



Empid	Name	Address	Bdate	Sex	Salary	Dno	Dname	Mgr_id	Pno	Pname	Pdno	Hrs

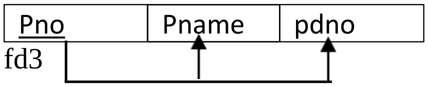
2)2nd NORMAL FORM:FD1AND FD3 VIOLATE 2NF CONDITION AS THEY ARE PARTIAL DEPENDENCIES,SO TABLE MUST BE DECOMPOSED

COMPANY1



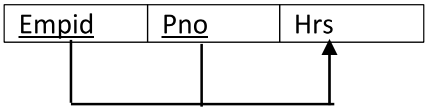
Empid	Name	Address	Bdate	Sex	Salary	Dno	Dname	Mgr_id

COMPAY2



Pno	Pname	pdno

COMPANY3

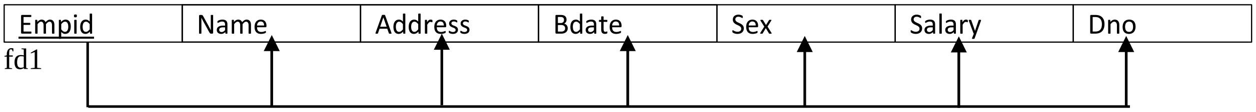


Empid	Pno	Hrs

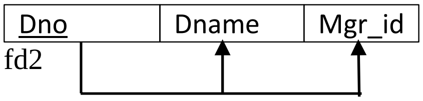
3) 3NF: - FOR 3NF,WE NEED TO REMOVE TRANSITIVE DEPENDENCIES.AS WE CAN SEE, EMPID DETERMINES DNO AND

DNO BY ITSELF CONSTITUES ANOTHER FUNCTIONAL DEPENDENCY, SO IT MUST BE DECOMPOSED.

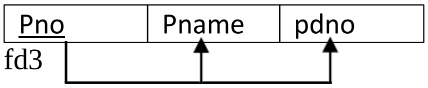
COMPANY11



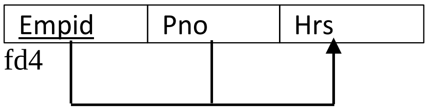
COMPANY12



COMPANY13



COMPANY14



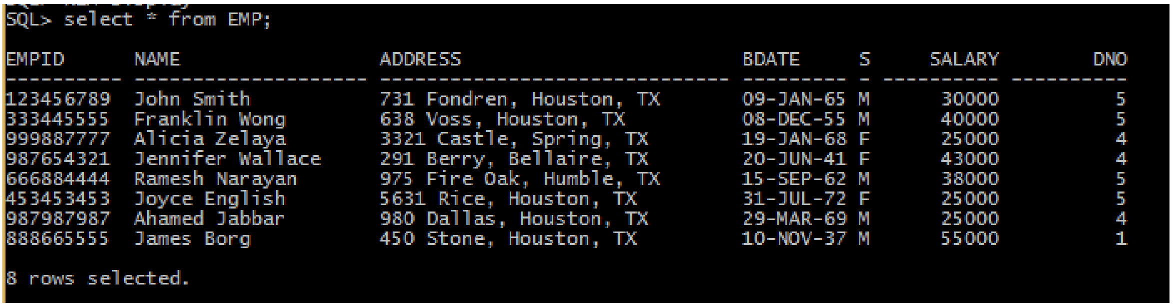
a) **To prove preservation of functional dependencies: -**
Consider the FD set as = **FD = {FD1, FD2, FD3, FD4}**
After the normalisation, the functional dependencies in each table are as follows:

COMPANY 11 PRESERVES **FD1**.
COMPANY 12 PRESERVES **FD2.**
COMPANY 13 PRESERVES **FD3.**
COMPANY 14 PRESERVES **FD4.**

So it can be seen that all FDs from the initial table are still preserved after decomposition.

b) To prove the normalization of the relation with the help of lose-less decomposition: -
Let us populate the initial table COMPANY with the following tuples.

COMPANY11(EMP)

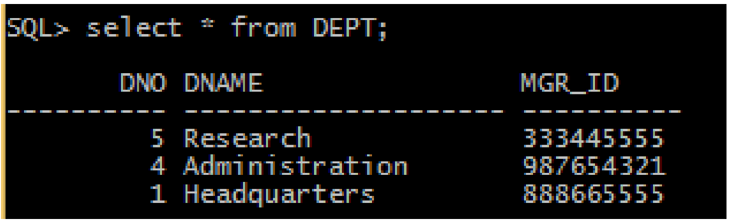


```
SQL> select * from EMP;

EMPID      NAME                 ADDRESS                        BDATE     S     SALARY        DNO
---------- -------------------- ------------------------------ --------- - ---------- ----------
123456789  John Smith           731 Fondren, Houston, TX       09-JAN-65 M      30000          5
333445555  Franklin Wong        638 Voss, Houston, TX          08-DEC-55 M      40000          5
999887777  Alicia Zelaya        3321 Castle, Spring, TX        19-JAN-68 F      25000          4
987654321  Jennifer Wallace     291 Berry, Bellaire, TX        20-JUN-41 F      43000          4
666884444  Ramesh Narayan       975 Fire Oak, Humble, TX       15-SEP-62 M      38000          5
453453453  Joyce English        5631 Rice, Houston, TX         31-JUL-72 F      25000          5
987987987  Ahamed Jabbar        980 Dallas, Houston, TX        29-MAR-69 M      25000          4
888665555  James Borg           450 Stone, Houston, TX         10-NOV-37 M      55000          1

8 rows selected.
```

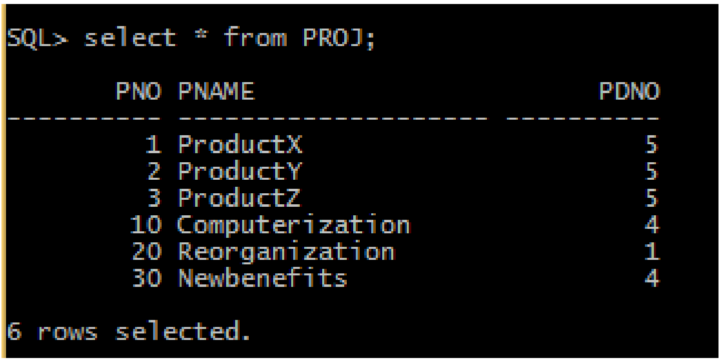
COMPANY12(DEPT)



```
SQL> select * from DEPT;

       DNO DNAME                MGR_ID
---------- -------------------- ----------
         5 Research             333445555
         4 Administration       987654321
         1 Headquarters         888665555
```

COMPANY13(PROJECT)

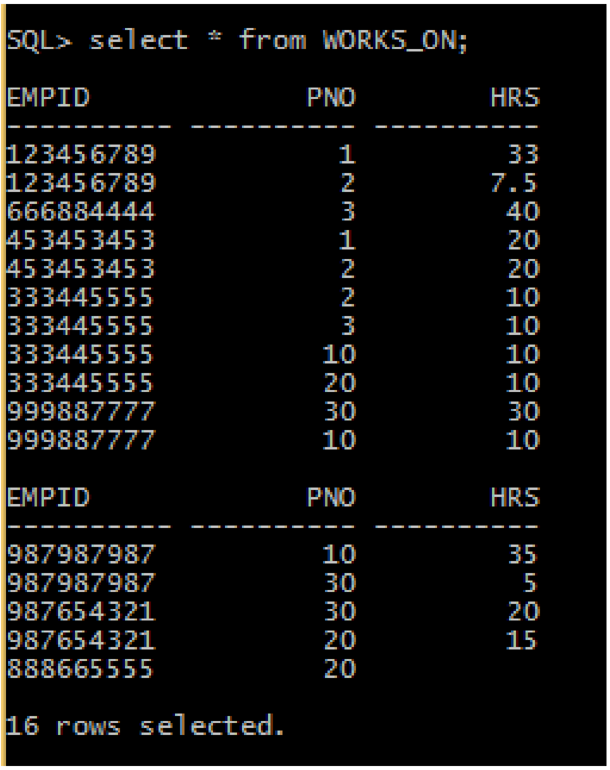


```
SQL> select * from PROJ;

       PNO PNAME                      PDNO
---------- -------------------- ----------
         1 ProductX                      5
         2 ProductY                      5
         3 ProductZ                      5
        10 Computerization               4
        20 Reorganization                1
        30 Newbenefits                   4

6 rows selected.
```

COMPANY14(WORKS ON)



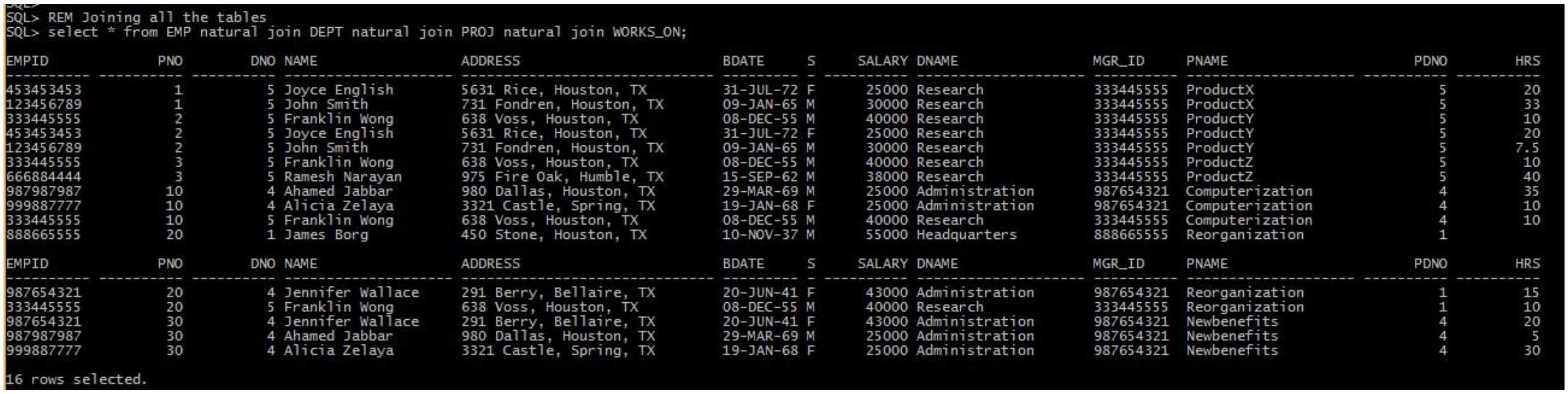
```
SQL> select * from WORKS_ON;

EMPID             PNO        HRS
---------- ---------- ----------
123456789           1         33
123456789           2        7.5
666884444           3         40
453453453           1         20
453453453           2         20
333445555           2         10
333445555           3         10
333445555          10         10
333445555          20         10
999887777          30         30
999887777          10         10

EMPID             PNO        HRS
---------- ---------- ----------
987987987          10         35
987987987          30          5
987654321          30         20
987654321          20         15
888665555          20

16 rows selected.
```

NOW WHEN WE APPLY A NATURAL JOIN TO ALL THESE TABLES WE GET :



```
SQL> REM Joining all the tables
SQL> select * from EMP natural join DEPT natural join PROJ natural join WORKS_ON;

EMPID             PNO        DNO NAME                 ADDRESS                        BDATE     S     SALARY DNAME                MGR_ID     PNAME                      PDNO        HRS
---------- ---------- ---------- -------------------- ------------------------------ --------- - ---------- -------------------- ---------- -------------------- ---------- ----------
453453453           1          5 Joyce English        5631 Rice, Houston, TX         31-JUL-72 F      25000 Research             333445555  ProductX                      5         20
123456789           1          5 John Smith           731 Fondren, Houston, TX       09-JAN-65 M      30000 Research             333445555  ProductX                      5         33
333445555           2          5 Franklin Wong        638 Voss, Houston, TX          08-DEC-55 M      40000 Research             333445555  ProductY                      5         10
453453453           2          5 Joyce English        5631 Rice, Houston, TX         31-JUL-72 F      25000 Research             333445555  ProductY                      5         20
123456789           2          5 John Smith           731 Fondren, Houston, TX       09-JAN-65 M      30000 Research             333445555  ProductY                      5        7.5
333445555           3          5 Franklin Wong        638 Voss, Houston, TX          08-DEC-55 M      40000 Research             333445555  ProductZ                      5         10
666884444           3          5 Ramesh Narayan       975 Fire Oak, Humble, TX       15-SEP-62 M      38000 Research             333445555  ProductZ                      5         40
987987987          10          4 Ahamed Jabbar        980 Dallas, Houston, TX        29-MAR-69 M      25000 Administration       987654321  Computerization               4         35
999887777          10          4 Alicia Zelaya        3321 Castle, Spring, TX        19-JAN-68 F      25000 Administration       987654321  Computerization               4         10
333445555          10          5 Franklin Wong        638 Voss, Houston, TX          08-DEC-55 M      40000 Research             333445555  Computerization               4         10
888665555          20          1 James Borg           450 Stone, Houston, TX         10-NOV-37 M      55000 Headquarters         888665555  Reorganization                1
EMPID             PNO        DNO NAME                 ADDRESS                        BDATE     S     SALARY DNAME                MGR_ID     PNAME                      PDNO        HRS
---------- ---------- ---------- -------------------- ------------------------------ --------- - ---------- -------------------- ---------- -------------------- ---------- ----------
987654321          20          4 Jennifer Wallace     291 Berry, Bellaire, TX        20-JUN-41 F      43000 Administration       987654321  Reorganization                1         15
333445555          20          5 Franklin Wong        638 Voss, Houston, TX          08-DEC-55 M      40000 Research             333445555  Reorganization                1         10
987654321          30          4 Jennifer Wallace     291 Berry, Bellaire, TX        20-JUN-41 F      43000 Administration       987654321  Newbenefits                   4         20
987987987          30          4 Ahamed Jabbar        980 Dallas, Houston, TX        29-MAR-69 M      25000 Administration       987654321  Newbenefits                   4          5
999887777          30          4 Alicia Zelaya        3321 Castle, Spring, TX        19-JAN-68 F      25000 Administration       987654321  Newbenefits                   4         30

16 rows selected.
```

2Q)

Consider the following set of requirements for a UNIVERSITY database that is used to keep track of students' transcripts.
(a) The database will keep student data (STUDENT) and stores each student's name (Sname, composed of first name (FName), last name (LName)), student id (Sid, unique for every student), address (Addr), phone (Phone), major code (Major), and date of birth (DoB), sex, degree (Degree) program (B.A., B.S., ..., Ph.D.) and minor (Minor) department (if any). A student is assigned to one primary academic department. It is required to keep track of the student's grades in each section the student has completed.

(b) Each department (DEPARTMENT) has a unique name (DName), a unique code number (DCode) and phone (Dphone) and college (College)

(c) A department offers a number of courses (COURSE), each of which has a unique course name (CoName), a unique code number (CCode), a course level (Level: this can be coded as 1 for freshman level, 2 for sophomore, 3 for junior, 4 for senior, 5 for MS level, and 6 for PhD level), a course credit hours (Credits), and a course description (CDesc).

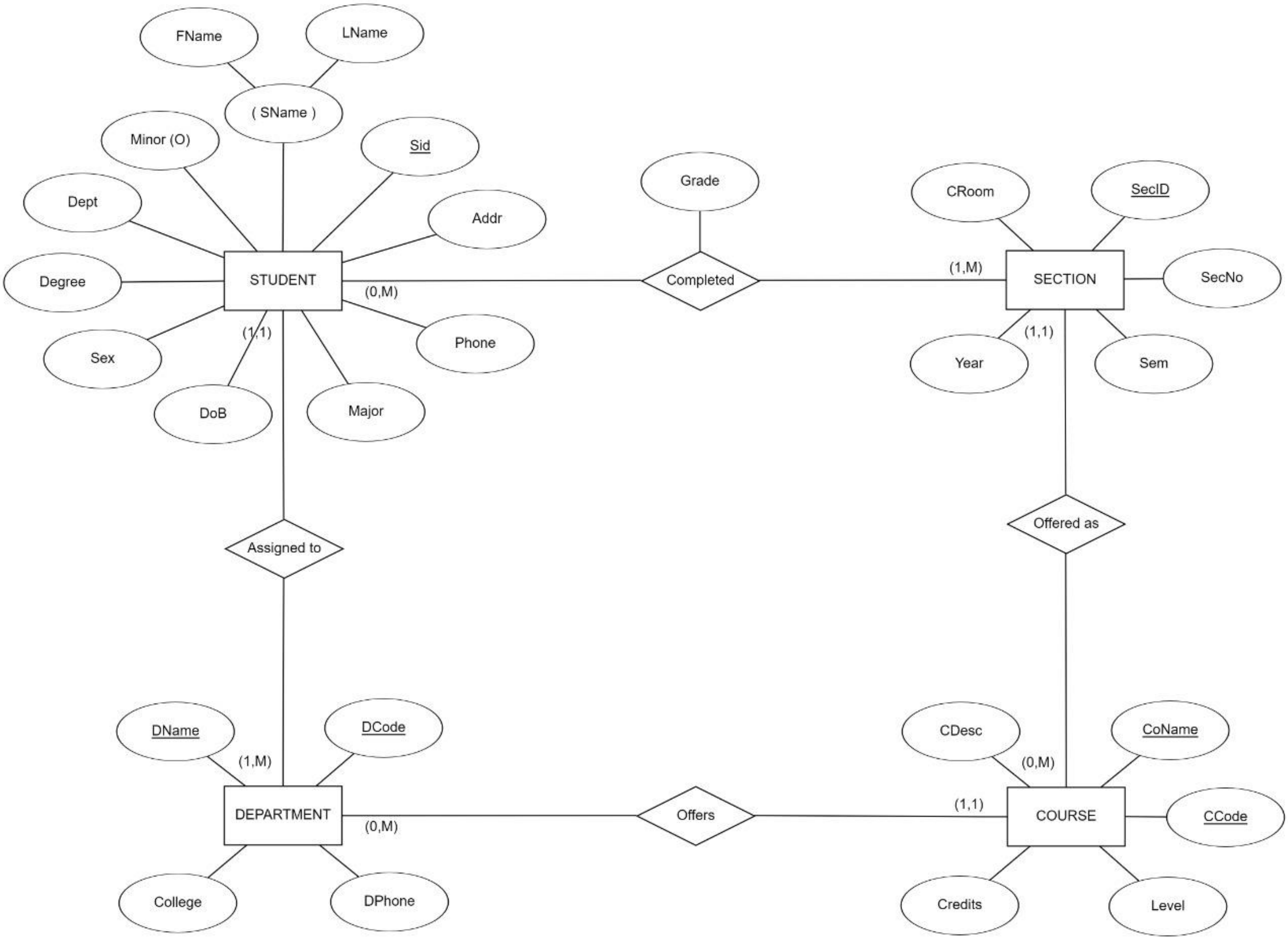
(d) Courses are offered as sections (SECTION). Each section is related to a single course and a single instructor and has a unique section identifier (SecId). A section also has a section number (SecNo: this is coded as 1, 2, 3, . . . for multiple sections offered during the same semester/year), semester (Sem), year (Year), classroom (Croom).

Notice that for the SECTION entity type, only SecID showed as an underlined key, but because of the miniworld constraints, other combinations of values have to be unique for each section entity.

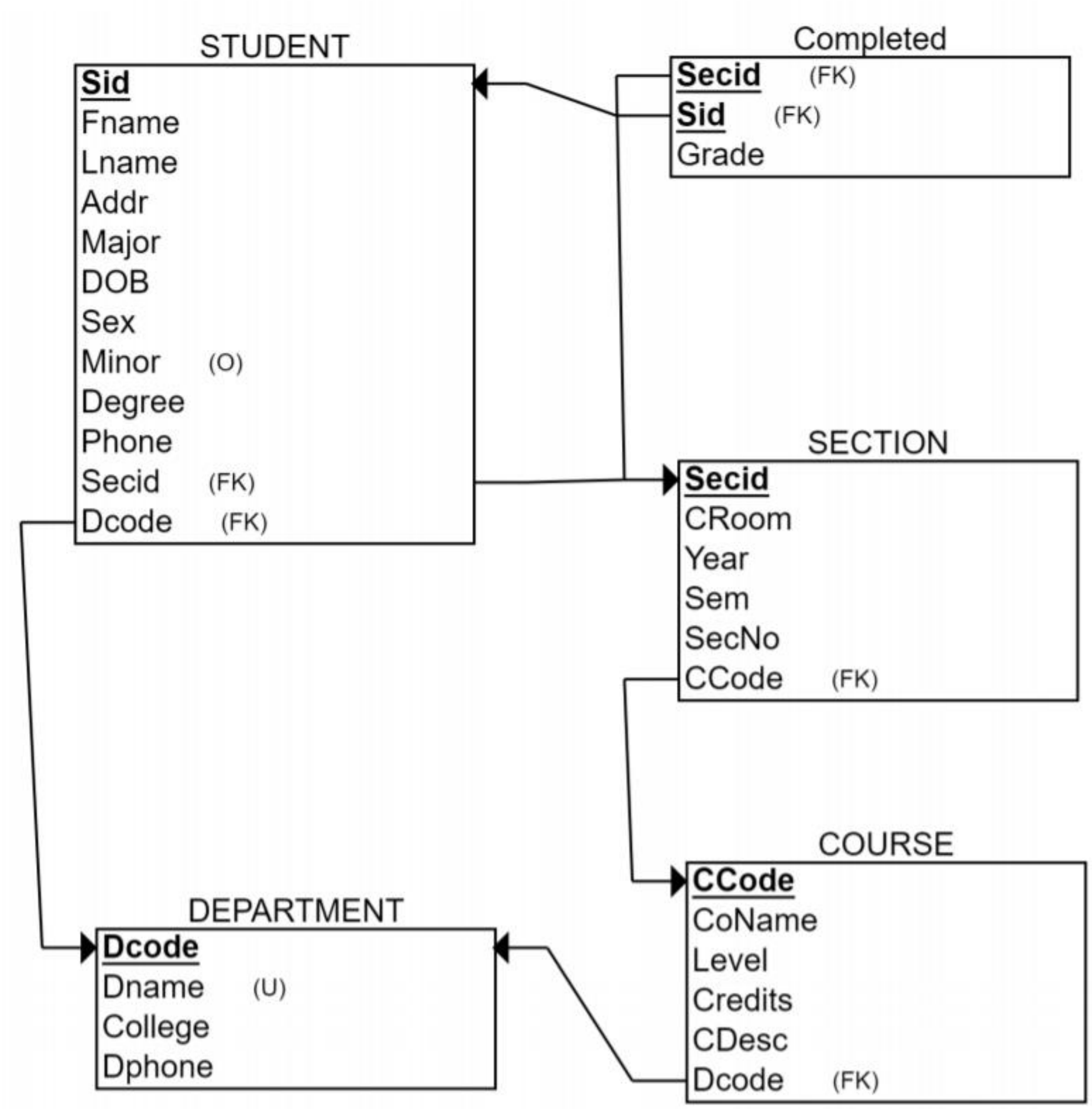
For example, consider the following:
(SecNo, Sem, Year, CCode (of the COURSE related to the SECTION)): This specifies that the section numbers of a particular course must be different during each particular semester and year.
1) Draw ER diagram for the above requirements. Mention the constraints in the diagram.
2) Convert the ER into the corresponding relations using ER-Relational Mapping.

DATABASE DESIGN:ER DIAGRAM

1)



2) ER TO RELATIONAL MAPPING


STUDENT
Sid
Fname
Lname
Addr
Major
DOB
Sex
Minor (O)
Degree
Phone
Secid (FK)
Dcode (FK)
Completed
Secid (FK)
Sid (FK)
Grade
SECTION
Secid
CRoom
Year
Sem
SecNo
CCode (FK)
COURSE
CCode
CoName
Level
Credits
CDesc
Dcode (FK)
DEPARTMENT
Dcode
Dname (U)
College
Dphone