NIBM WORLD WIDE

SOFTWARE ENGINEERING

DATABASE MANAGEMENT SYSTEMS

SCHEMA MAPPING

National Institute of Business Management

Lesson 04 – Schema Mapping

Schema Mapping

Primary Key

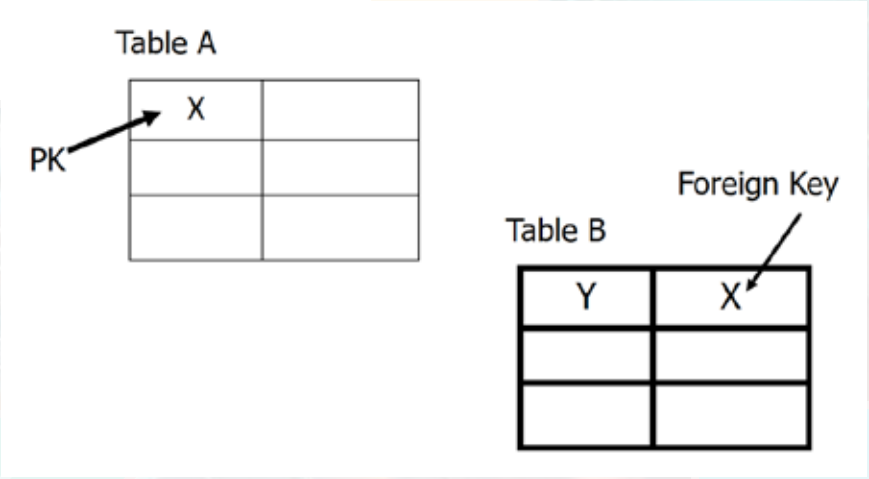
One of the candidate keys, is assigned as the primary key. The primary key is used to identify tuples in a relation.

Candidate Key

It is a set of attributes that uniquely identify tuples (rows) in a table? The Primary key should be selected from the candidate keys. Every table must have at least a single candidate key.

Foreign Key

A field in a table which links another related table. If field X is the primary key of table A and also appears in table B, it is a foreign key in table B.



Relational Model Constraints

The various types of constraint that can be specified on a relational database schema includes:

- **Domain Constraints**

  Domain constraints specify that the value of each attribute must be atomic.

- **Key Constraint**

  No two tuples can have the same combination of values for all their attributes.

- **Entity Integrity Constraint**

  This constraint states that no primary key value can be null. This is because the primary key value is used to identify individual tuples in a relation.

- **Referential Integrity Constraints**

A tuple in one relation that refers to another relation must refer to an existing tuple in that relation.

Department Table

Dno	Dname
1	Admin
2	Accounts
3	Marketing

PK

Employee Table

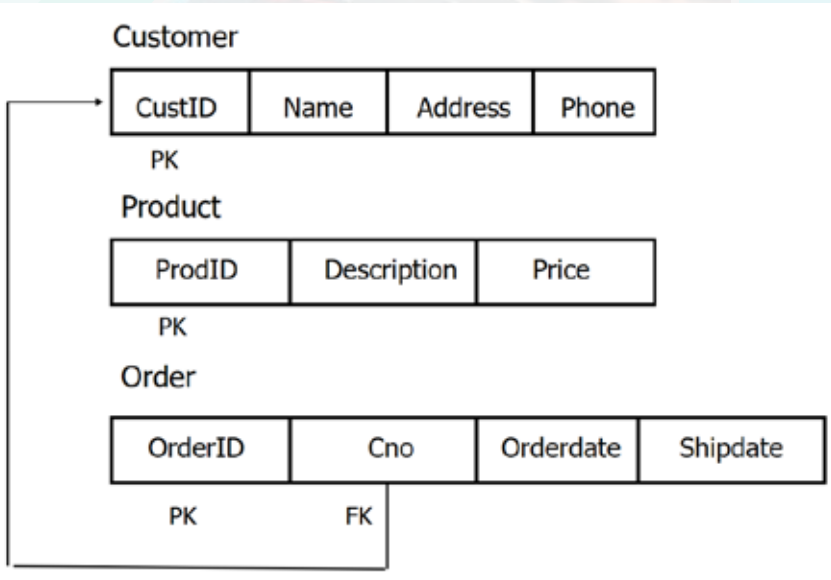
Eno	Ename	Dnum
100	Perera	2
200	Silva	1
300	Yapa	4

PK FK

Violating the Referential Integrity Constraint.
There is no Department No called 4 in Department Table

Schema

The description of the database is called the database schema. A database schema is specified during database design and is not expected to change frequently. A displayed schema is called a schema diagram. A schema diagram displays only some aspects of a schema, such as the name of the record types, data items and some types of constraints. A sample schema diagram is given below.



Conversion of ER model to Relational Schema (7 Steps)

Step 1:

For each **strong entity** type in the ER diagram create a relation that includes all the simple attributes of the entity.

- Any **composite attributes** must be represented as basic attributes.
- Omit **multi-valued /derived** attributes.

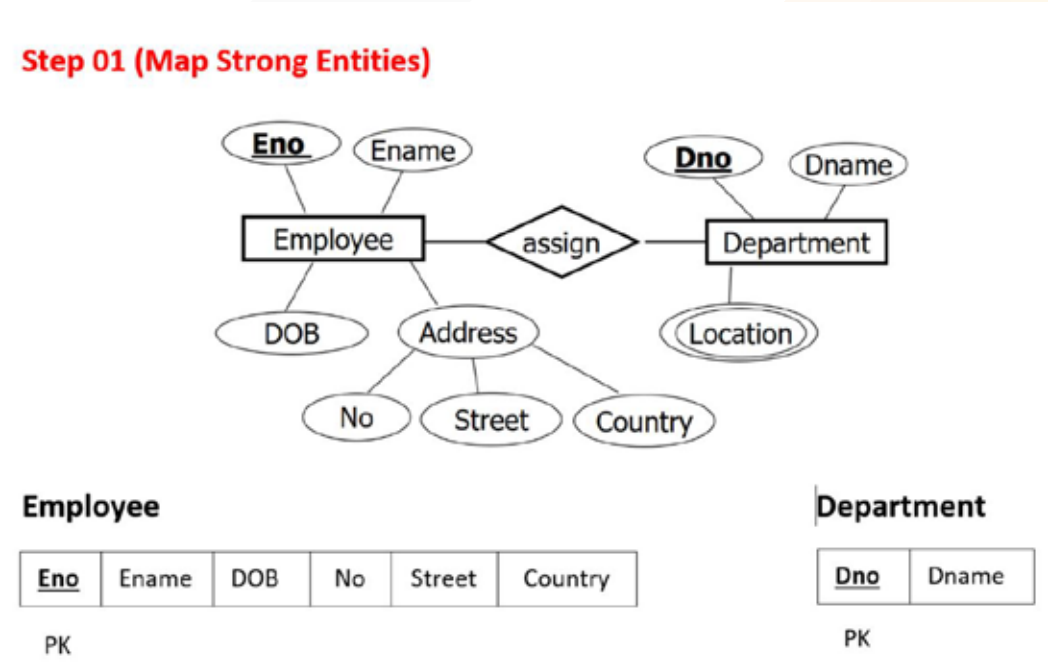


Figure 4.0.1 Conversion of ER to Schema (Step 01)

Step 2:

For each **weak entity type**, create a new relation

- Include all the attributes of the weak entity.
- Add the **primary key** of the strong entity (owner entity) as a **foreign key**.
- The primary key of the weak entity will be a **combination of the owner entity and the partial key of the weak entity**.

Step 02 (Map Weak Entities)

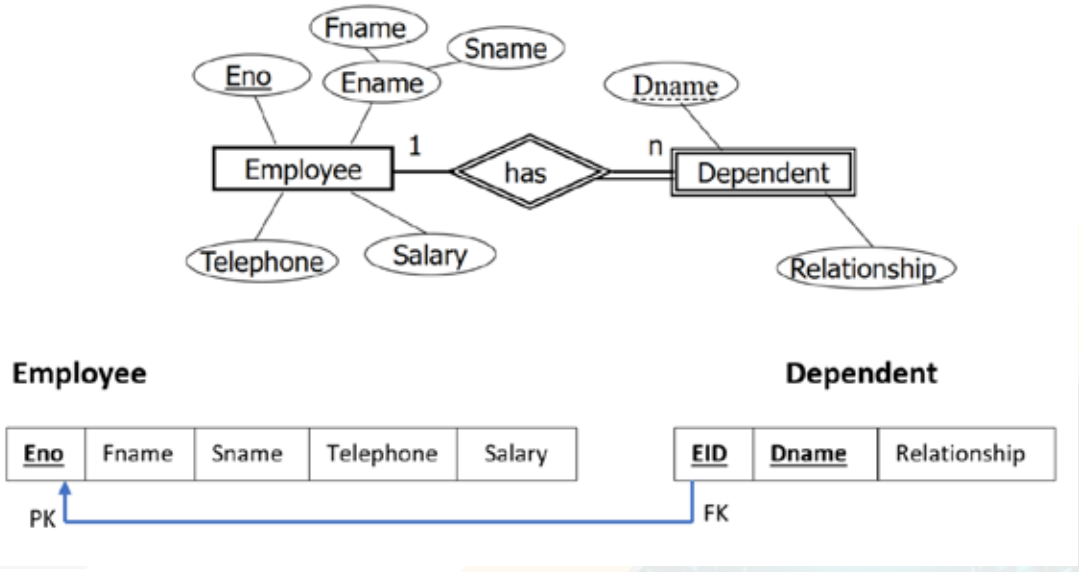


Figure 4.0.2 Conversion of ER to Schema (Step 02)

Employee

Eno	Fname	Sname	Telephone	Salary
E1	Kamala	Perera	076	16000
E2	Waruna	Weerasinghe	071	18000
E3	Amali	Perera	076	20000

Dependent

EID	Dname	Relationship
E3	Pathum	Husband
E2	Kanchana	Wife
E2	Gayan	Child
E1	Pathum	Husband
E1	Gayan	Child

Both EID and Dname together create **COMPOSITE PRIMARY KEY**

Step 3:

For **1:1 relationship**, select any side of the relation (but it is better to choose an entity type with a **total participation**)

- Indicate the primary key on one relation as the **foreign key** in the other relation (selected entity type).
- Include all simple attributes of the 1:1 relationship type as an attribute of the chosen entity type.

Step 03 (Map 1:1 Relationship)

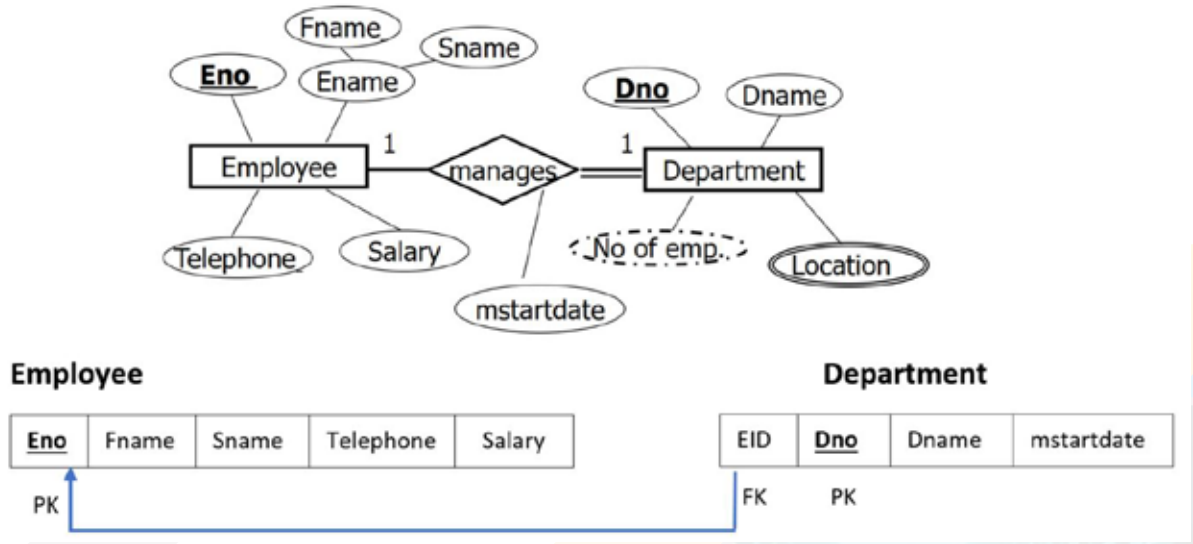


Figure 4.0.3 Conversion of ER to Schema (Step 03)

Employee

Eno	Fname	Sname	Telephone	Salary
E1	Kamala	Perera	076	16000
E2	Waruna	Weerasinghe	071	18000
E3	Amali	Perera	076	20000
E4	Sadun	Fernando	071	25000

Department

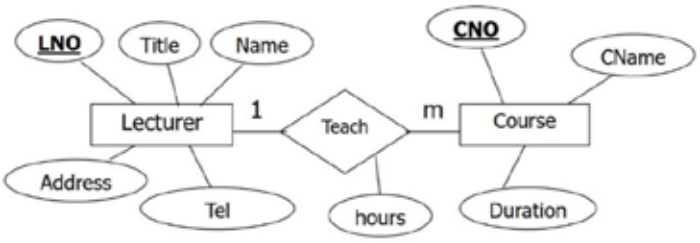
EID	Dno	Dname	mstartdate
E2	D1	HR	2012-1-5
E4	D2	Marketing	2015-6-9
E1	D3	Accounts	2016-5-9
E3	D4	MIS	2019-6-3

Step 4:

For **1:m relationships** select the **many side** of the relation and indicate the primary key of the one side as the **foreign key on the many side**.

- If you have any attributes in the relationship type add that also to the many side.

Step 04 (Map 1:m Relationship)



Lecturer

LNO	Title	Name	Address	Tel

PK

Course

LID	CNO	CName	Duration	hours

FK PK

Figure 4.0.4 Conversion of ER to Schema (Step 04)

Lecturer

LNO	Title	Name	Address	Tel
L1	Mr	Kasun	Col	071
L2	Mr	Waruna	Col07	076
L3	Mrs	Amali	Galle	071
L4	Mrs	Saduni	Galle	072

Course

LID	CNO	CName	Duration	hours
L1	C1	DSE	1Y	45
L1	C2	DCSD	1Y	60
L3	C3	DNE	1Y	45
L3	C4	CCS	3M	66
L1	C5	CSE	3M	69

Step 5:

For **m:n relationships** create a **new relation**

- Contain the primary keys of the two relations
- Any attributes on the relationship type

Step 6:

For **multi valued attributes** create a **new relation** with containing the

- Multi valued attribute and
- The Primary key of the entity

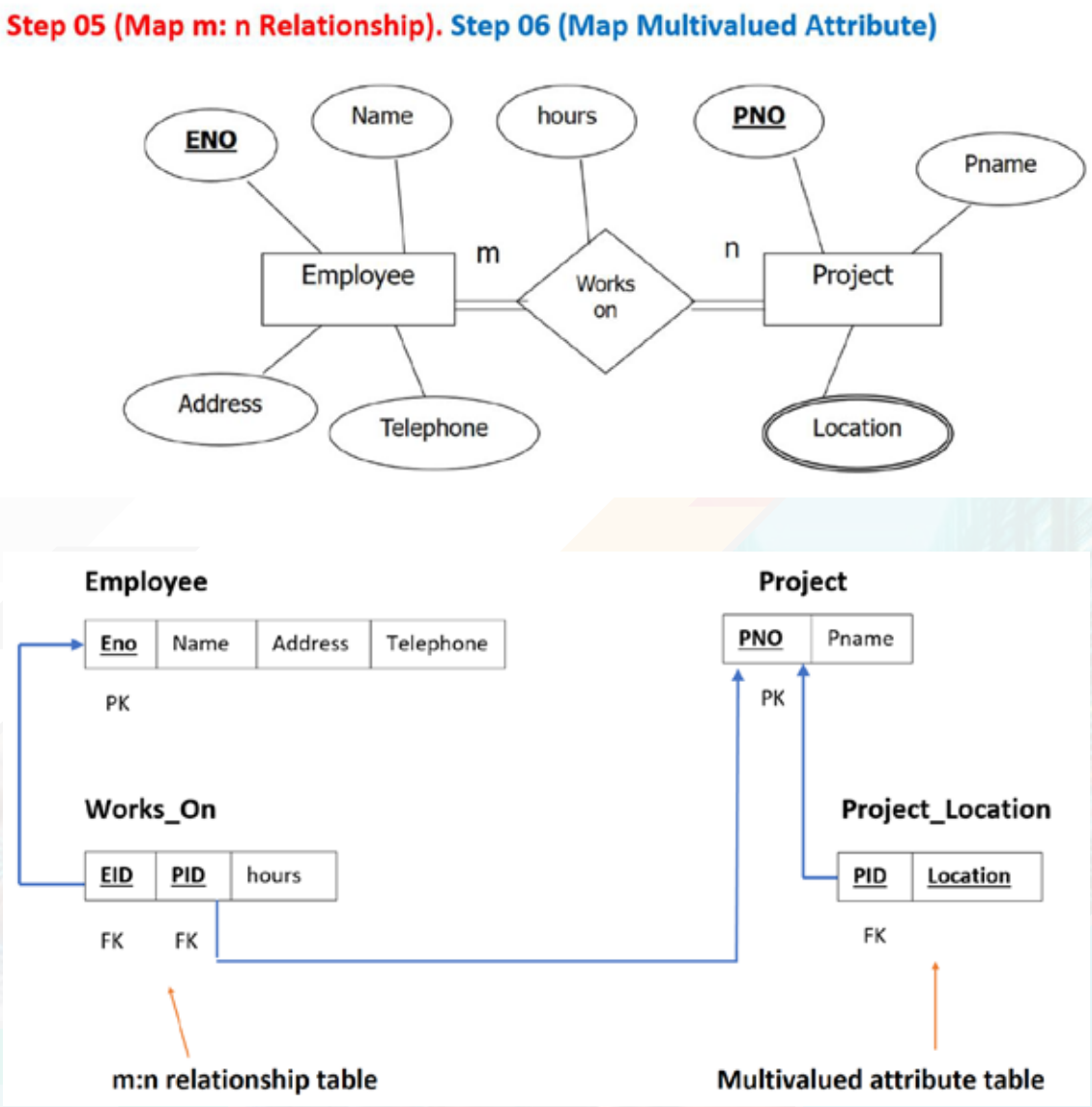


Figure 4.0.5 Conversion of ER to Schema (Step 05 and Step 06)

Employee

Eno	Name	Address	Telephone
E1	Kamala	Col07	076
E2	Waruna	Galle	071
E3	Amali	Col08	076
E4	Sadun	Col09	071

Works_On

EID	PID	Hours
E1	P4	60
E1	P2	45
E1	P3	90
E2	P3	45
E2	P4	60
E4	P1	20
E4	P3	45

Project

PNO	Pname
P1	RoadCons
P2	BridgeCons
P3	HouseConstr
P4	ApartmentCons

Project_Location

PID	Location
P1	Kotte
P1	Galle
P1	Matala
P2	Galle
P2	Kottawa
P3	Matara

Step 7:

For **n-ary relationship** types create a new relation

- Include attributes of the relationship type
- All primary keys of the entities participating in the n-ary relationship.

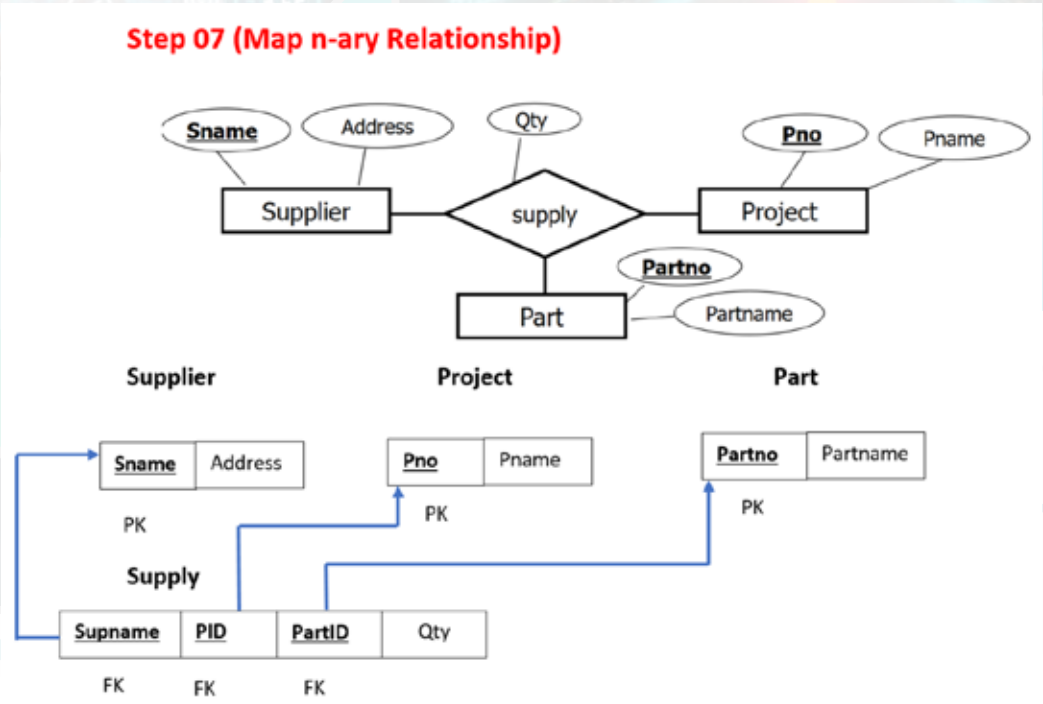


Figure 4.0.6 Conversion of ER to Schema (Step 07)

You must follow step by step when you map the ER to a Schema. Also remember you have to create a new table (relation) in 3 conditions.

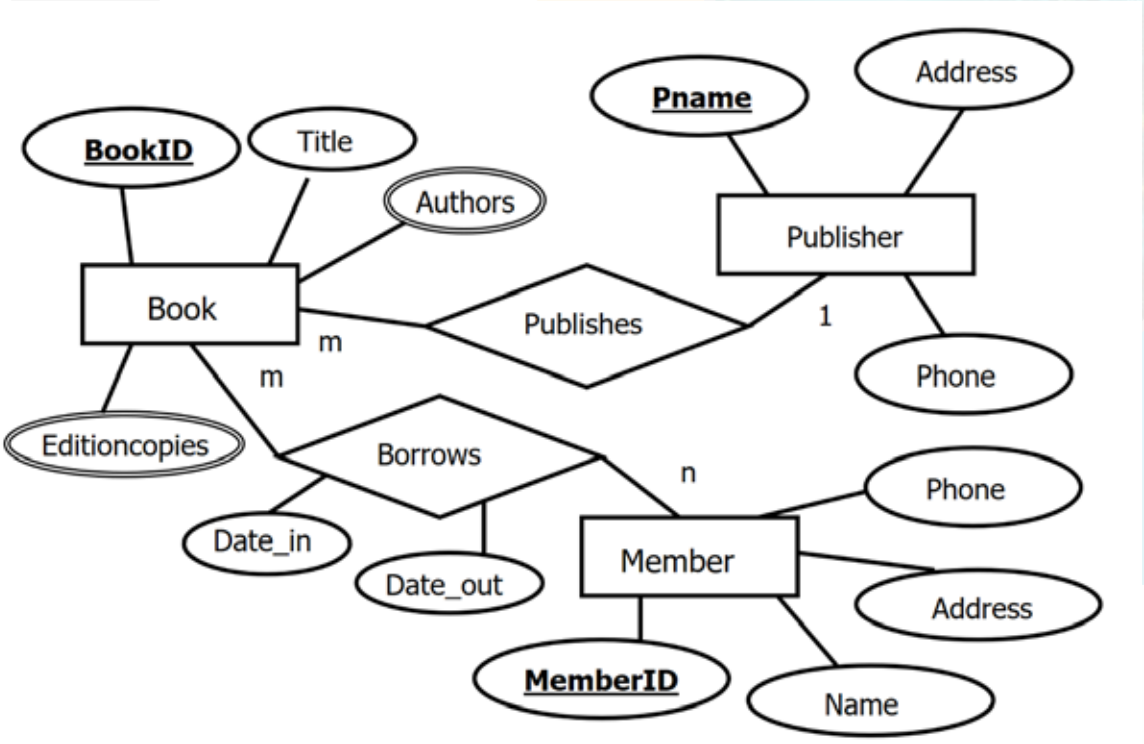
1. m:m relationship (Step 05)

2. Multivalued (Step 06)

3. n-ary relationship (Step 07)

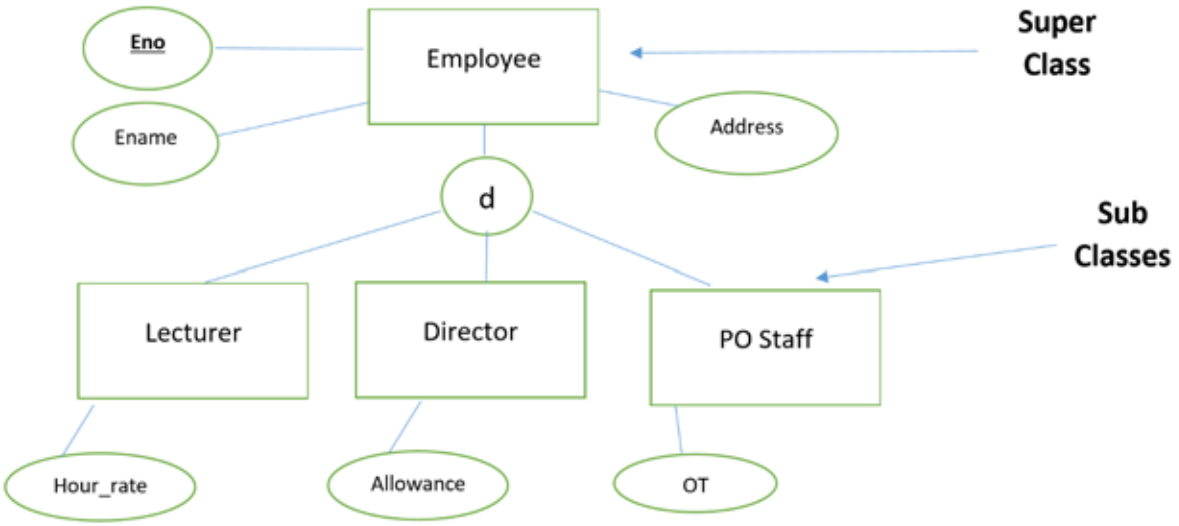
Exercise 01:

Design a database schema that corresponds to the following Library database ER diagram.



Mapping EER model to a Relational Model

Consider the following EER Example.



Option A

Create a relation for super class with attributes.

Also create relations for each subclass with attributes.

Employee

Eno	Ename	Address

Lecturer

Eno	Hour_rate

Director

Eno	Allowance

PO_Staff

Eno	OT

Option B

Create a relation for each sub class with attributes.

Lecturer

Eno	Ename	Address	Hour_rate

Director

Eno	Ename	Address	Allowance

Po_Staff

Eno	Ename	Address	OT

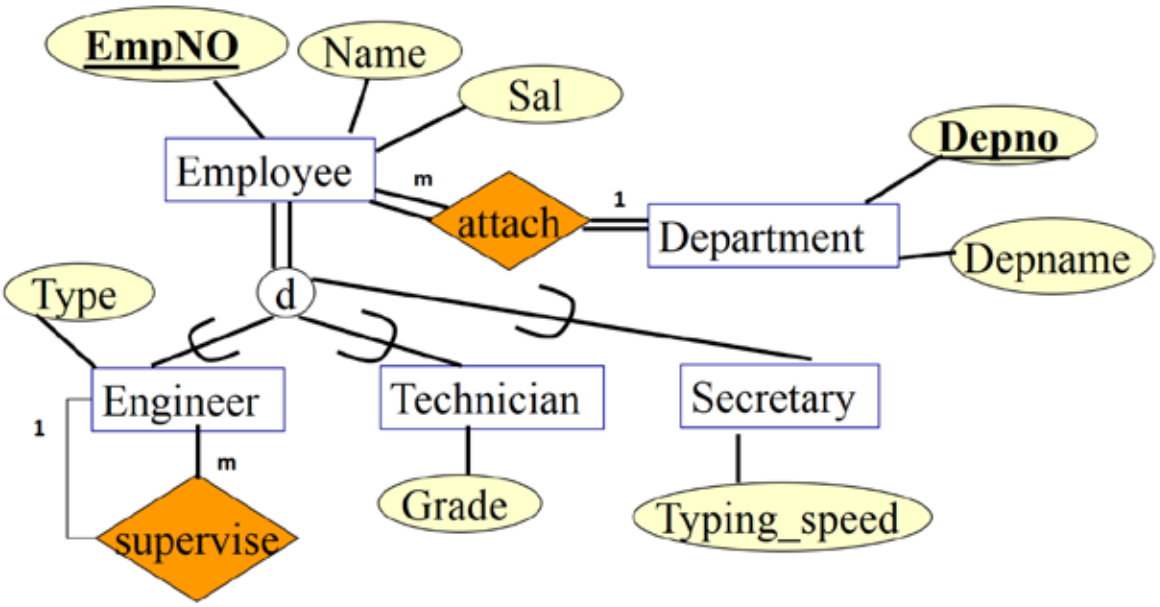
Option C

Create a relation for each sub class with attributes.

Employee

Eno	Ename	Address	Hour_rate	Allowance	OT

Example



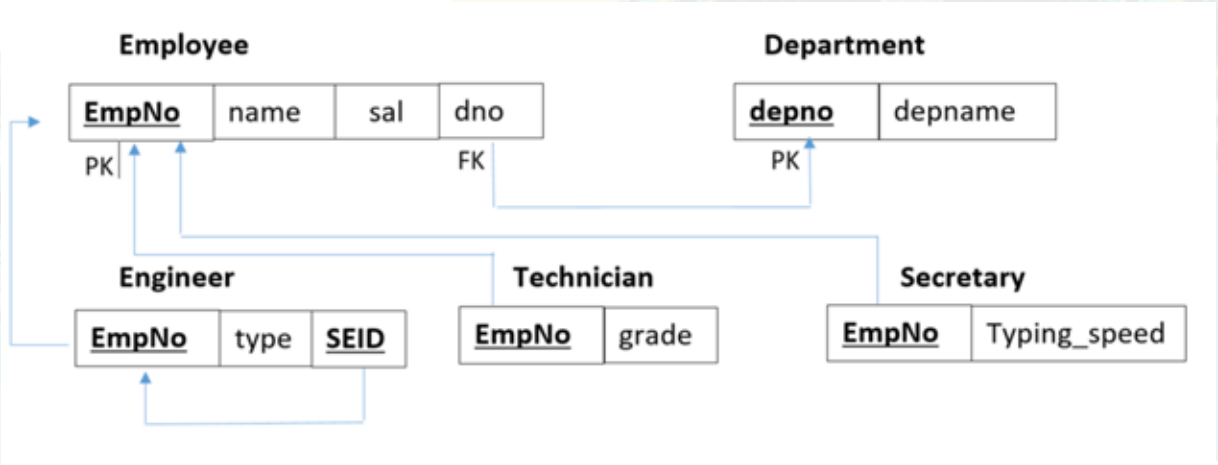


Figure 4.0.13 EER Example Mapping to Schema using Option A

Employee

EmpNo	Name	Sal	Dno
E1	Kasun	15000	D1
E2	Amali	25000	D1
E3	Waruna	36000	D2
E4	Pathum	75000	D3
E5	Supun	85000	D2

Department

Depno	Depname
D1	HR
D2	Marketing
D3	Accounts
D4	Admin

Engineer

EmpNo	Type	SEID
E2	Senior	null
E3	Junior	E2
E5	Junior	E2

Technician

EmpNo	Grade
E1	A Grade

Secretary

EmpNo	Typing_speed
E4	35wpm

Figure 4.0.14 Practical Tables for EER Example

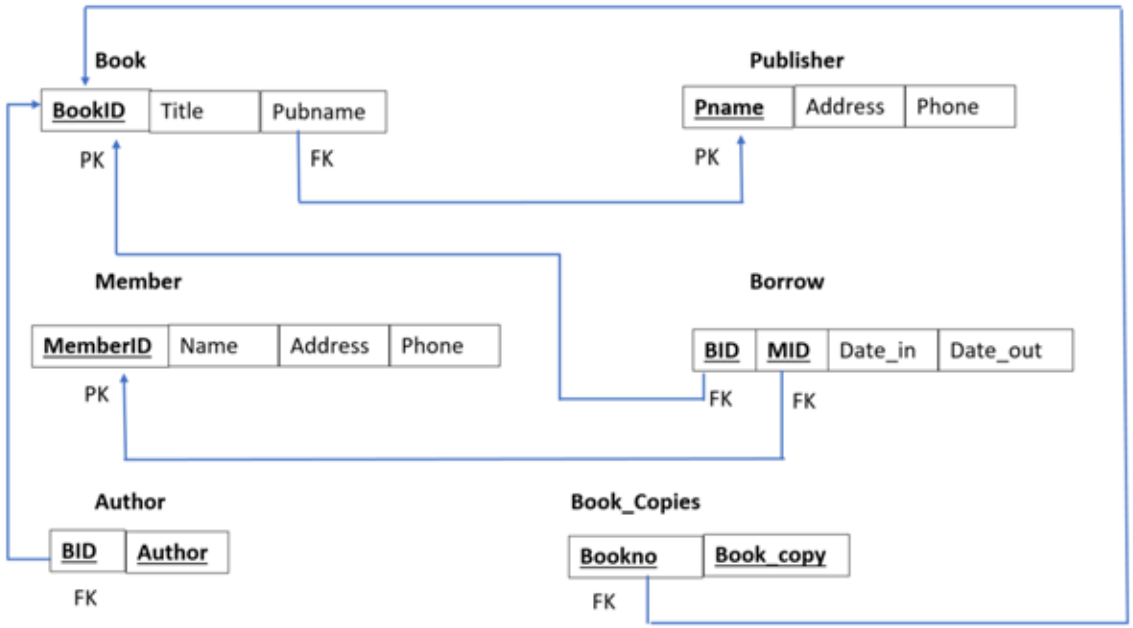
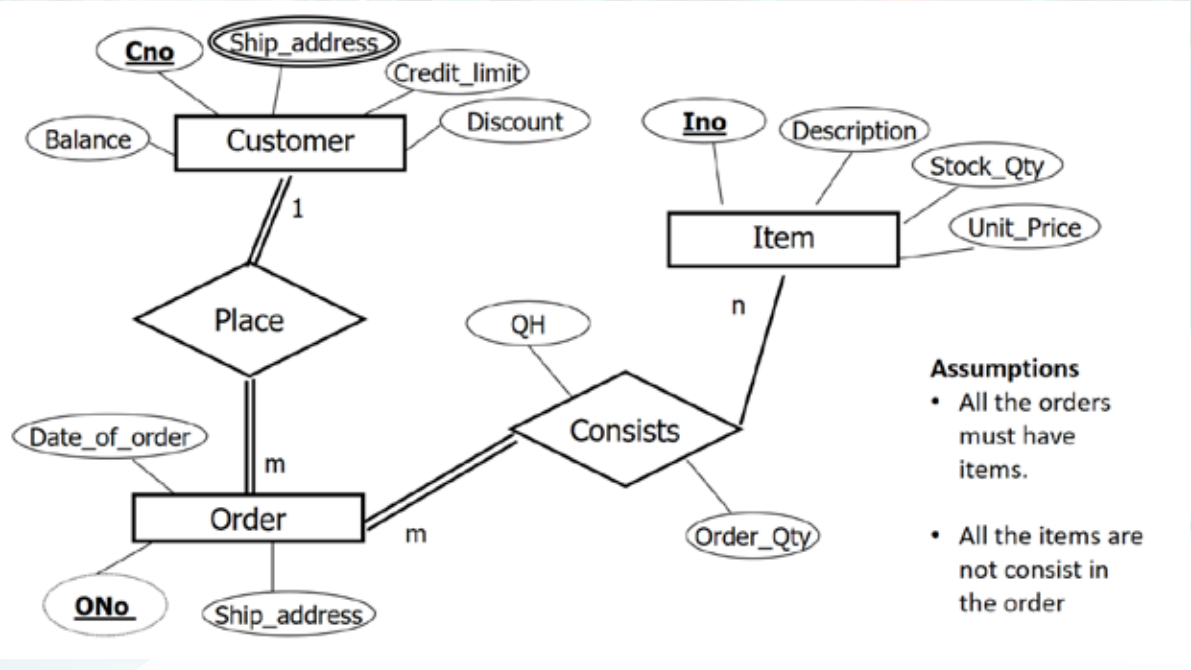


Figure 4.0.7 Schema Mapping Exercise 01

Exercise 02:

Design a database schema that corresponds to the Order entry system ER diagram.



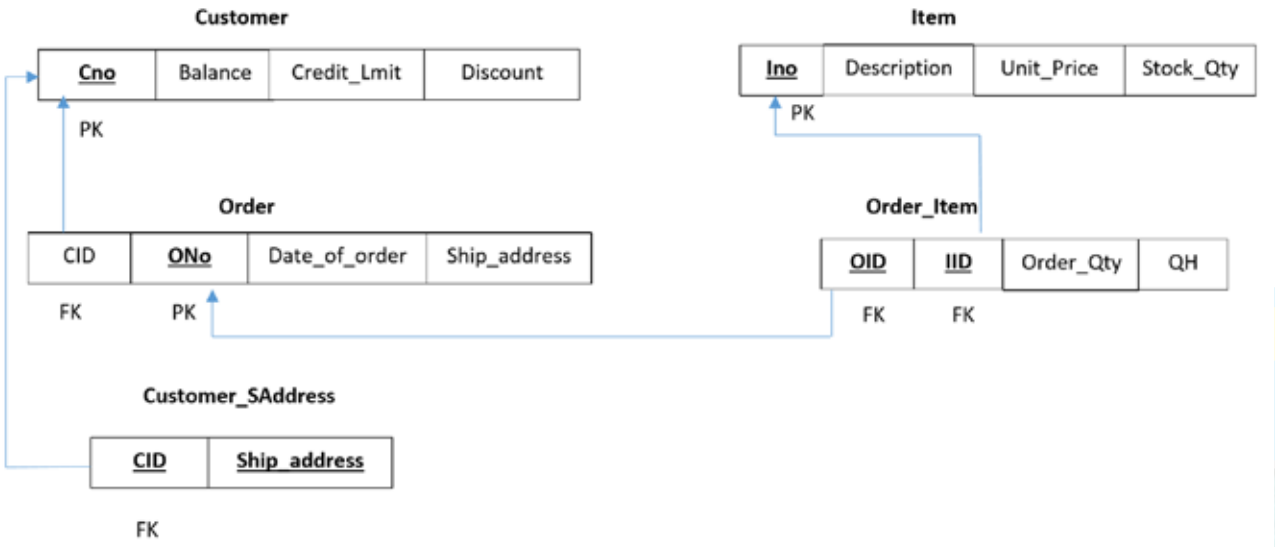


Figure 4.0.8 Schema Mapping Exercise 02

Practical Tables for Order Entry System

Customer

Cno	Balance	Credit_Limit	Discount
C1	10000	10000	1500
C2	15000	1500	2000
C3	16000	15000	1400
C4	5000	60007	7000

Item

Ino	Description	Unit_Price	Stock_Qty
I1	Hard Disk	15000	4300
I2	Pen Drive	2000	1000
I3	Mouse	2000	500
I4	Monitor	10000	6000

Order

CID	Ono	Date_of_order	Ship_address
C1	O1	2012-1-5	Kotte
C1	O2	2015-5-6	Nugegoda
C3	O3	2012-1-5	Kottawa
C4	O4	2012-6-1	Galle

Order_Item

OID	IID	Order_Quantity	QH
O1	I1	200	4800
O1	I3	100	900
O1	I4	100	5900
O2	I3	150	750
O2	I4	300	5600
O3	I1	500	4300
O3	I3	250	500

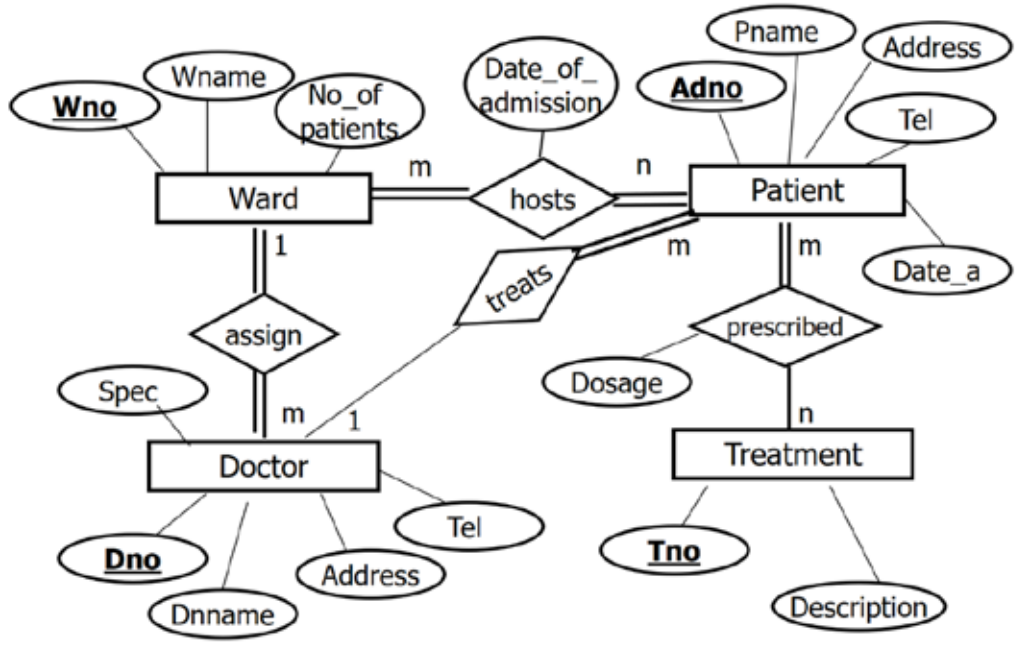
Customer_SAddress

CID	Ship_address
C1	Kotte
C1	Kottawa
C1	Galle
C2	Galle
C2	Kotte
C3	Kotte
C3	Matale

Figure 4.0.9 Practical Tables for Exercise 02

Exercise 03:

Design a database schema that corresponds to the Hospital ER diagram.



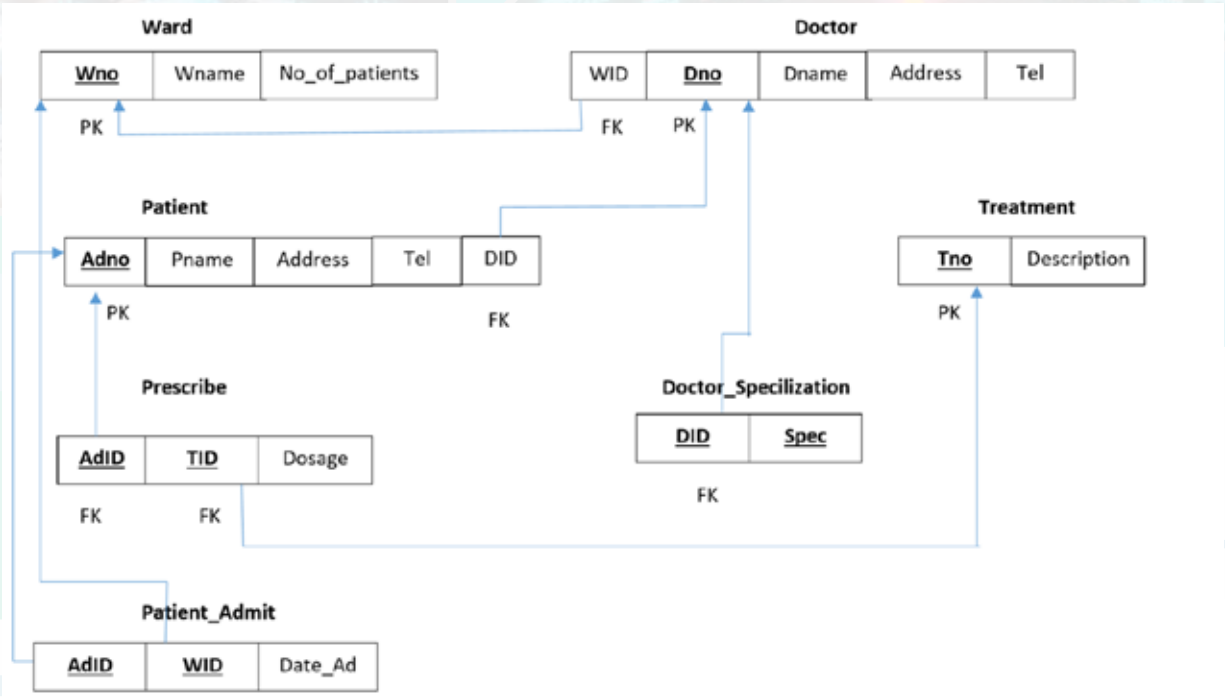


Figure 4.0.10 Schema Mapping Exercise 03

Practical Tables for Hospital Management System

Ward

Wno	Wname	No_of_patients
W1	Heart	50
W2	ICU	100
W3	Brain	40

Doctor

Dno	Dname	Address	Tel	WID
D1	Perera	Col	071	W1
D2	Amali	Galle	072	W1
D3	Warnui	Col7	073	W2

Patient

Adno	Pname	Address	Tel	DID
P1	Gayan	Col	071	D2
P2	Danuka	Galle	072	D2
P3	Waruna	Col7	073	D3

Treatment

Tno	Description
T1	Panadol
T2	Anti
T3	Piriton

Prescribe

ADID	TID	Dosage
P1	T1	50
P1	T2	10
P1	T3	50
P2	T3	10
P2	T2	50
P3	T2	60
P3	T2	50

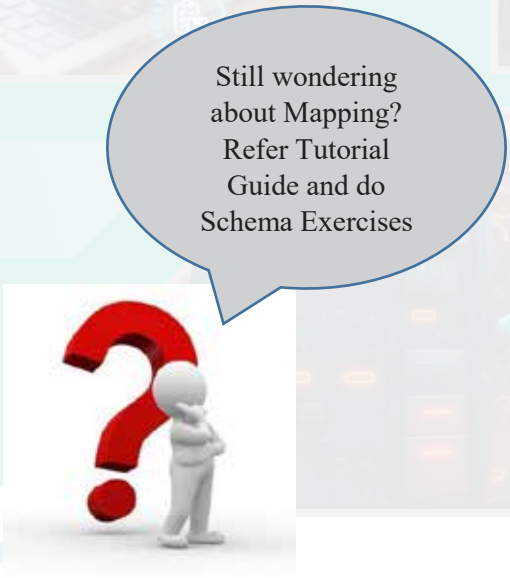
Doctor_Specilization

DID	Spec
D1	Heart
D1	Brain
D1	Covid
D2	Heart
D2	By Pass
D3	Heart

Patient_Admit

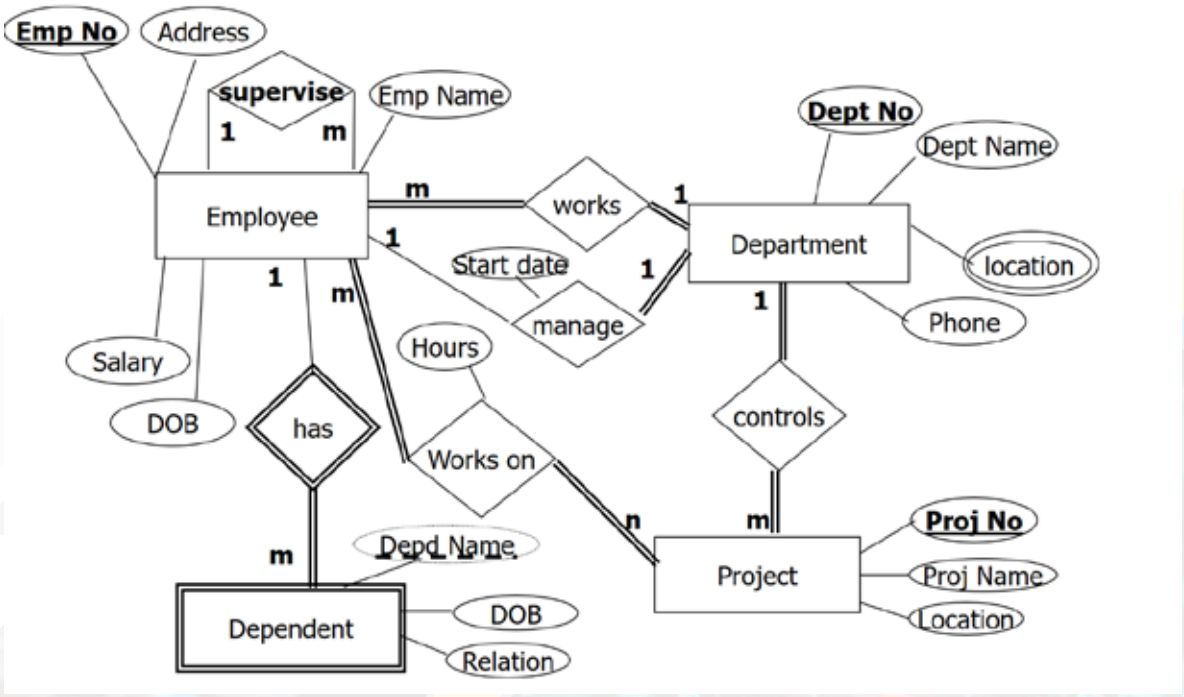
ADID	WID	Date_Ad
P1	W1	2012-01-05
P1	W2	2014-05-04
P1	W3	2016-06-05
P2	W1	2014-09-06
P2	W3	2015-09-06
P3	W2	2014-11-06
P3	W3	2015-02-22

Figure 4.0.11 Practical Tables for Exercise 03



Exercise 04:

Design a database schema that corresponds to the Company ER diagram.



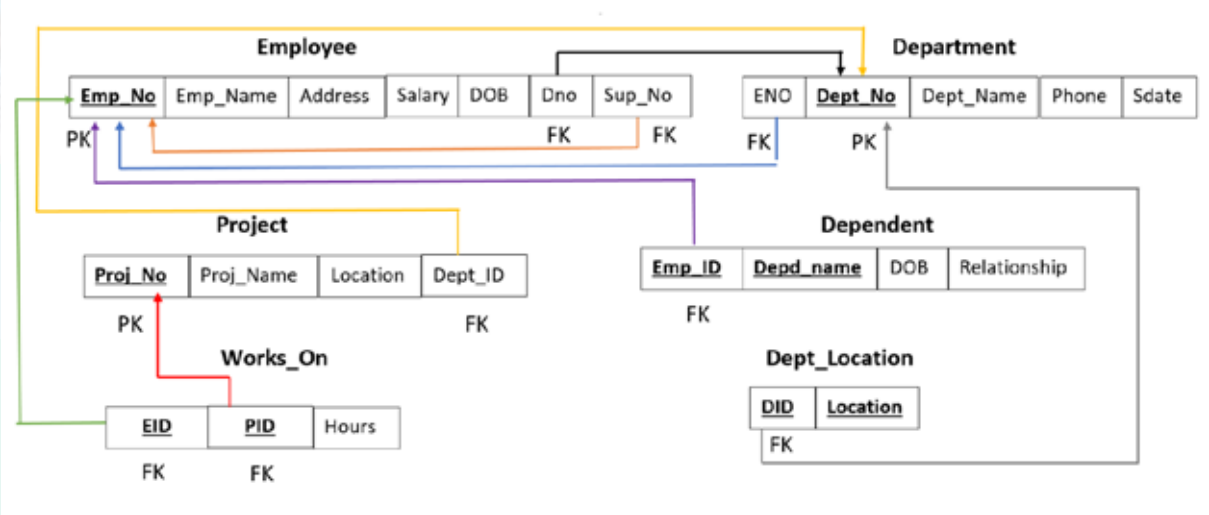


Figure 4.0.12 Schema Mapping Exercise 04