

E-R Diagram

E-R Model & Relational Model

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E-R Diagram Notations & Options

TERMINOLOGY

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- ❖ Key (or) Candidate Key
- ❖ Descriptive Attribute

- ❖ Relationship
- ❖ Relationship Set
- ❖ Identifying Relationship Set

- ❖ Entity
- ❖ Entity Set
- ❖ Weak Entity Set

Class Hierarchies

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- ❖ Specialization
- ❖ Overlapping Constraints
- ❖ Covering Constraints

❖ Aggregation

- ❖ No Constraint
- ❖ Key Constraint
- ❖ Participation Constraint
- ❖ Key & Participation Constraint

Business Rules

E-R Diagram Notations & Options

Attribute :-

An **Entity** is described using a **set of attributes**

empid, ename, gender → attributes describes the employee

Entity:-

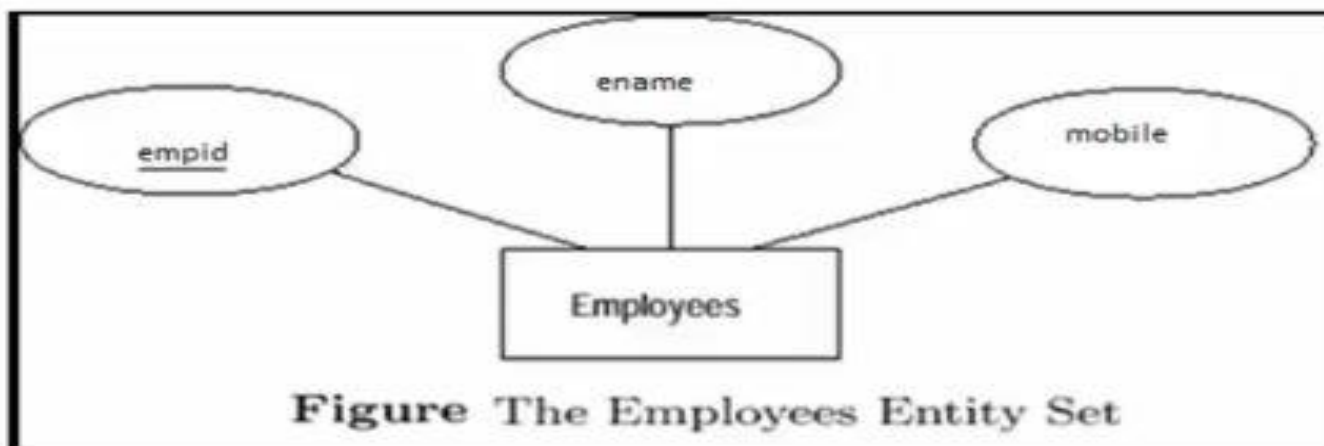
An Entity is a real world object which has both attributes and behavior

I am an entity. Bcoz I have name, mobile, e.t.c and I do teaching..

ENTITY SET

An Entity Set is a collection of similar entities...

{prakash, navatha, pranavi} → Entity Set



E-R Diagram Notations & Options

Relationship

A **Relationship** is an association among 2 (or) more entities.

Prakash **works_in** IT Dept

works_in is the relationship

RELATIONSHIP SET

A **Relationship Set** is a Collection of similar relationships

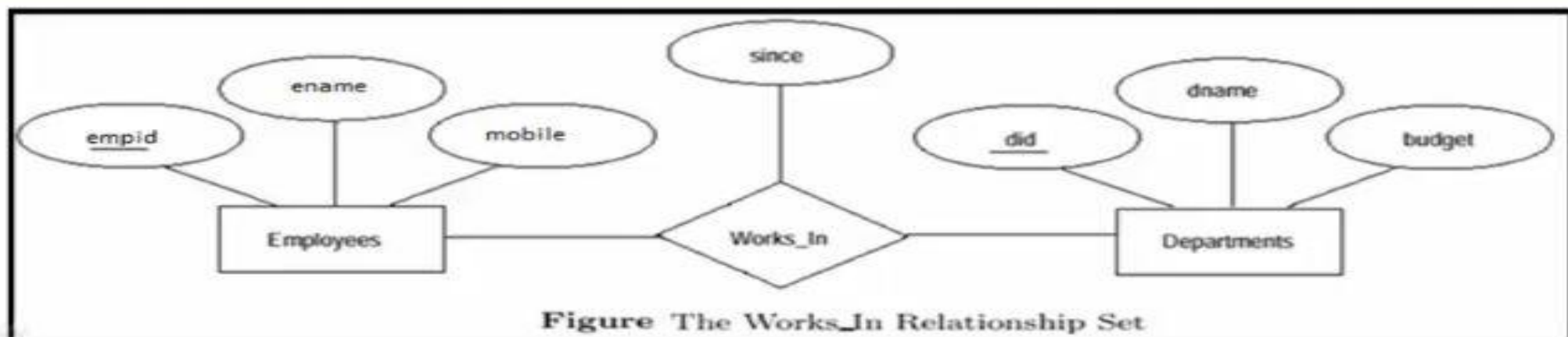
Prakash **works_in** IT Dept

Navatha **works_in** IT Dept

Descriptive Attribute

A **Relationship** can have descriptive attributes.

Since of **works_in** is a descriptive attribute



E-R Diagram Notations & Options

NO Constraint

Business Rule:- An employee can work in many department

Can an employee exists with out working in any dept ?

YES

Can an employee exists working in one department ?

YES

Can an employee exists working in two departments ?

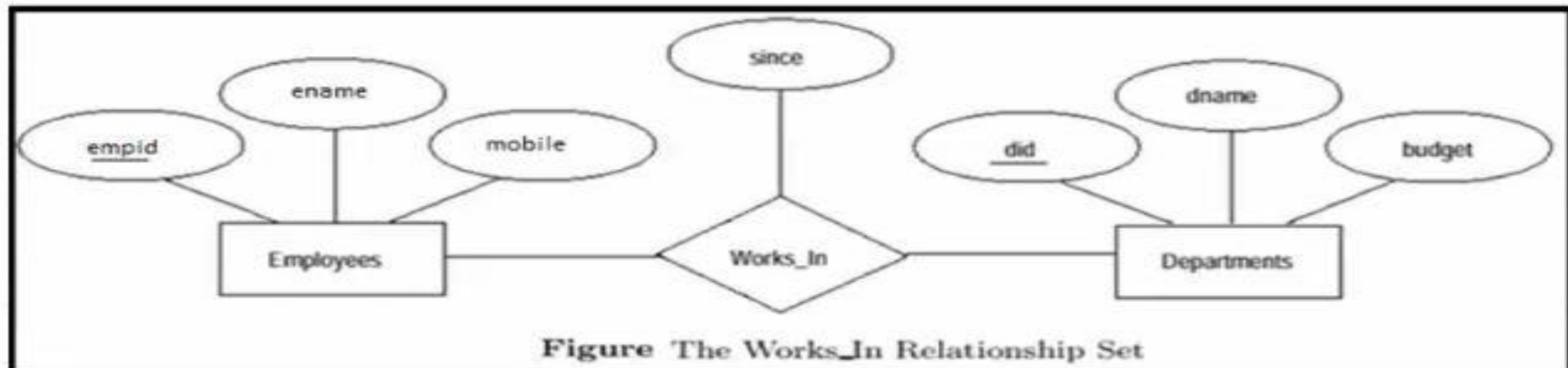
YES

Min and Max no of dept's an employee can work ?

Min = 0

Max = n

Possible Values = {0,1,2,...n}



E-R Diagram Notations & Options

Key Constraint

Business Rule:- An employee can work in at most one department

Can an employee exists with out working in any dept ?

YES

Can an employee exists working in one department ?

YES

Can an employee exists working in two departments ?

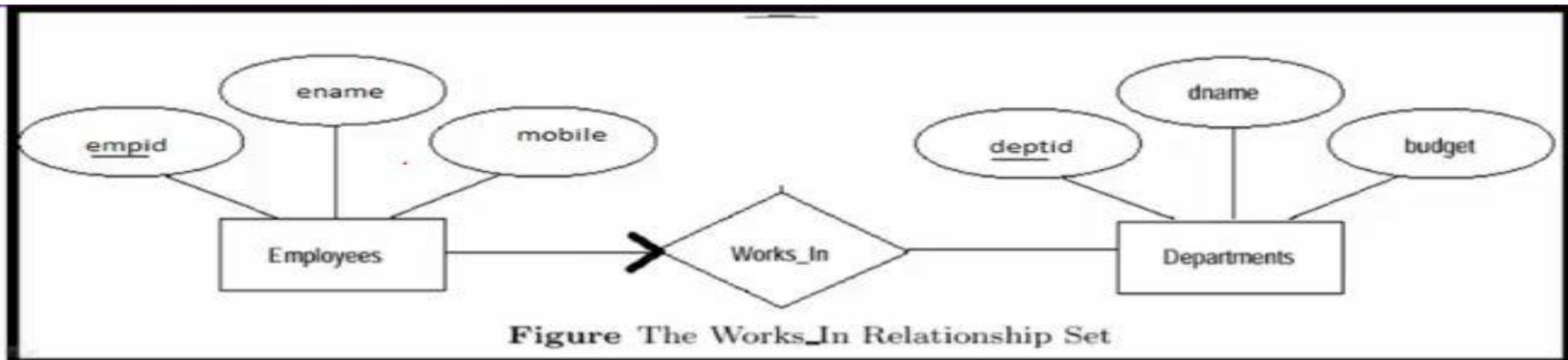
NO

Min and Max no of dept's an employee can work ?

Min = 0

Max = 1

Possible Values = {0,1}



E-R Diagram Notations & Options

Participation Constraint

Business Rule:- Every employee must work for a department

Can an employee exists with out working in any dept ?

NO

Can an employee exists working in one department ?

YES

Can an employee exists working in two departments ?

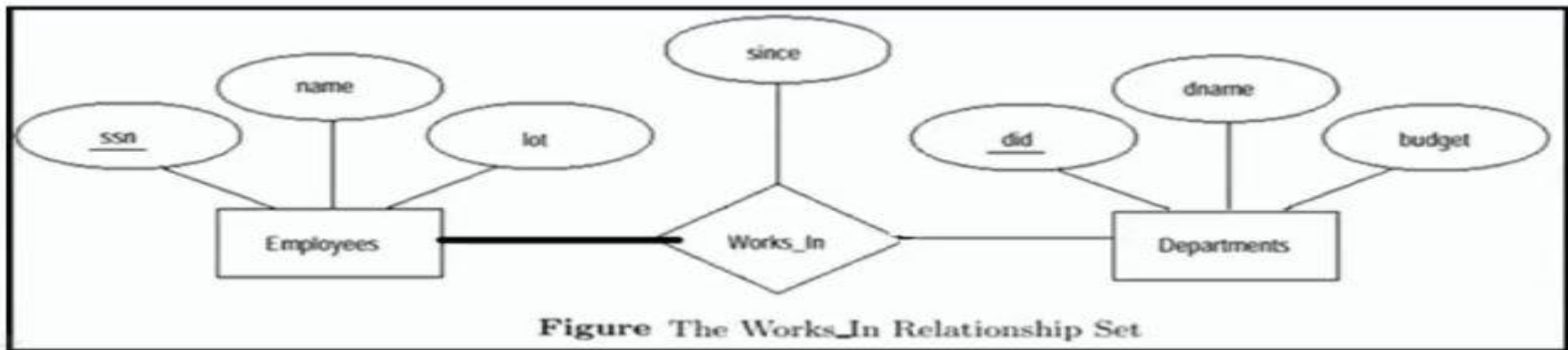
YES

Min and Max no of dept's an employee can work ?

Min = 1

Max = n

Possible Values = {1,2,3,...,n}



E-R Diagram Notations & Options

Participation & Key Constraint

Every employee must work for a department and at most one dept

Can an employee exists with out working in any dept ?

NO

Can an employee exists working in one department ?

YES

Can an employee exists working in two departments ?

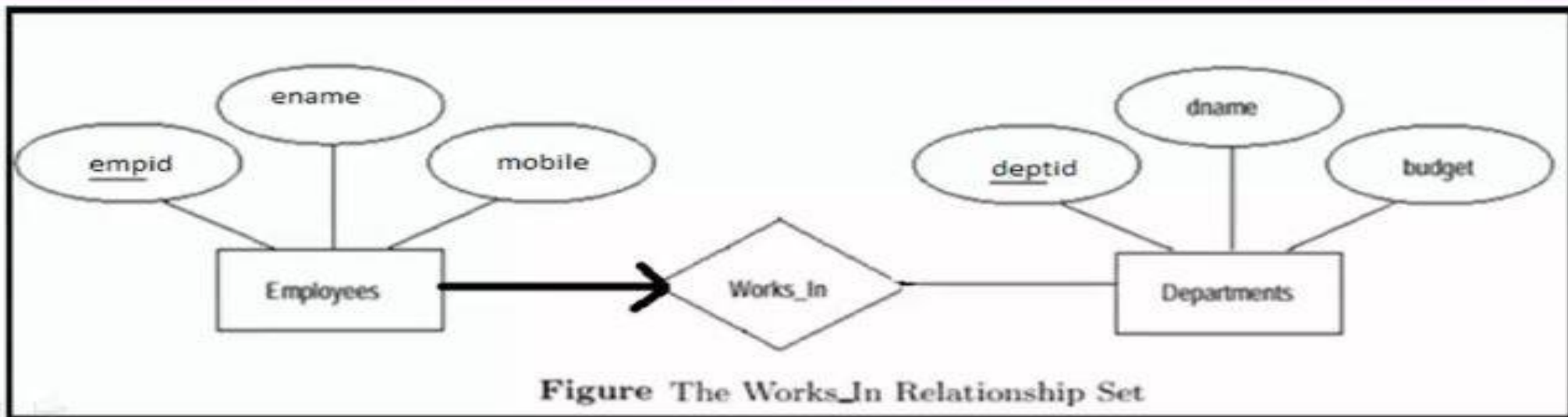
NO

Min and Max no of dept's an employee can work ?

Min = 1

Max = 1

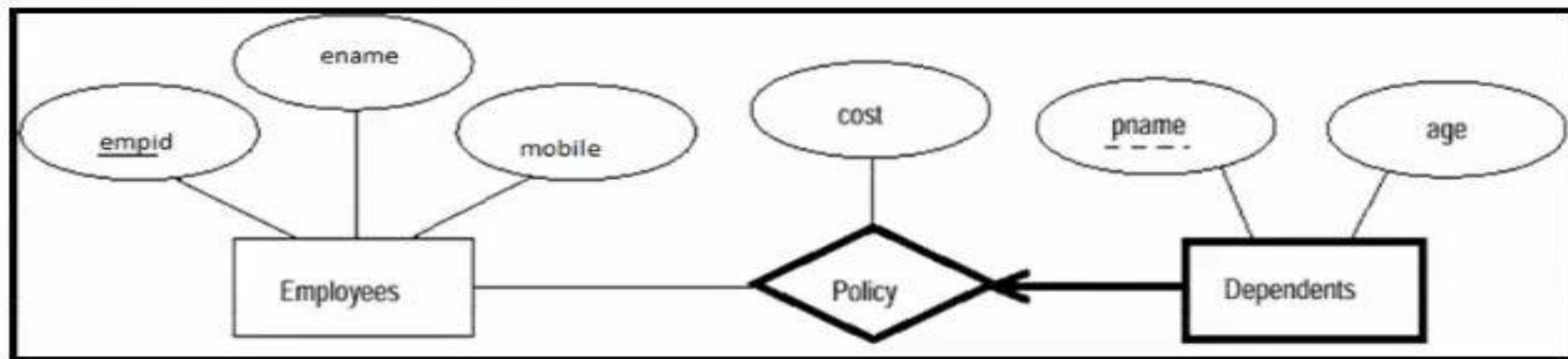
Possible Values = {1}



E-R Diagram Notations & Options

Weak Entity

Entity without Key Attribute is called Weak Entity



Identifying Relationship

Weak Entity

The following restrictions must hold:-

- 1) The owner entity set and the weak entity set participation is one-to-many.
- 2) The weak entity set must have total participation in the identifying relationship set.

CLASS HIERARCHIES

Classification of entities in an entity set into subclasses.

Employees Entity Set = Hourly Employees Entity Set + Contract Employees Entity Set

Super Class

Employees Entity Set

Sub Classes

Hourly Employees Entity Set

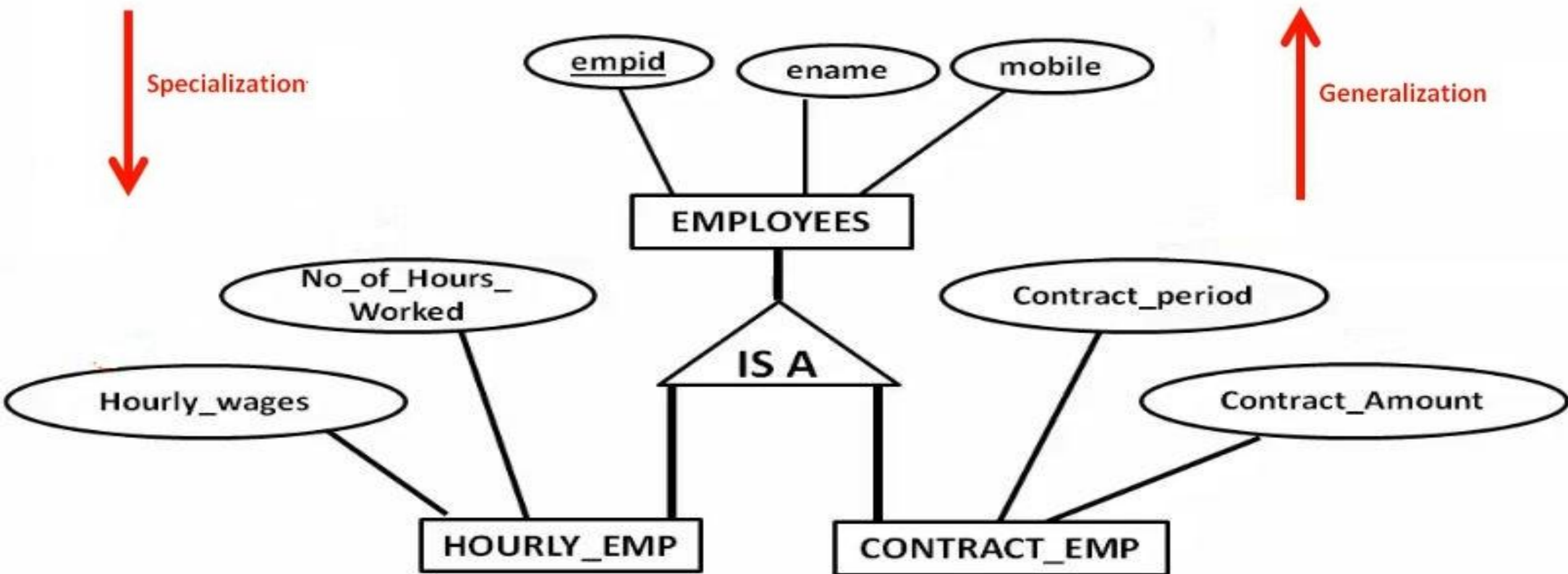
Contract Employee Entity Set

eno	ename	salary	mobile
1	a	30000	9844235891
2	b	40000	7854235891
3	c	50000	9888235891
4	d	20000	9866235891

After dividing the employees into 2 categories { Contract & Hourly }

eno	ename	mobile	contract_period	contract_amount	hourly_wage	no_of_hours_worked
1	a	9844235891	6 months	6 lakhs		
2	b	7854235891			300	444
3	c	9888235891	10 months	8 lakhs		
4	d	9866235891			550	284

CLASS HIERARCHIES



E-R Diagram Notations & Options

CLASS HIERARCHIES

Overlap Constraints

Can an entity belongs to 2 (or) more subclasses ?

Can Prakash Entity be both an Hourly Employee Entity & Contract Employee Entity?

NO

Can Prakash Entity be both an Contract Employee Entity & Senior Employee Entity?

YES



Contract Employees **OVERLAPS** Senior Employees

Hourly_Emp \cap Contract_Emp

=

$\{\Phi\}$

Hourly_Emp doesn't **Overlaps** with Contract_Emp

Contract_Emp \cap Senior_Emp

\neq

$\{\Phi\}$

Contract_Emp **Overlaps** with Senior_Emp

E-R Diagram Notations & Options

CLASS HIERARCHIES

Covering Constraints

All Entities in all subclasses = super class (or) not

For example, does every Employees entity have to belong to one of its subclasses?

YES



Hourly Employees AND Contract Employees **COVER** Employees

Hourly_Emp **U** Contract_Emp

=

EMP

Hourly_Emp & Contract_Emp
Covers EMP

Contract_Emp **U** Senior_Emp

!=

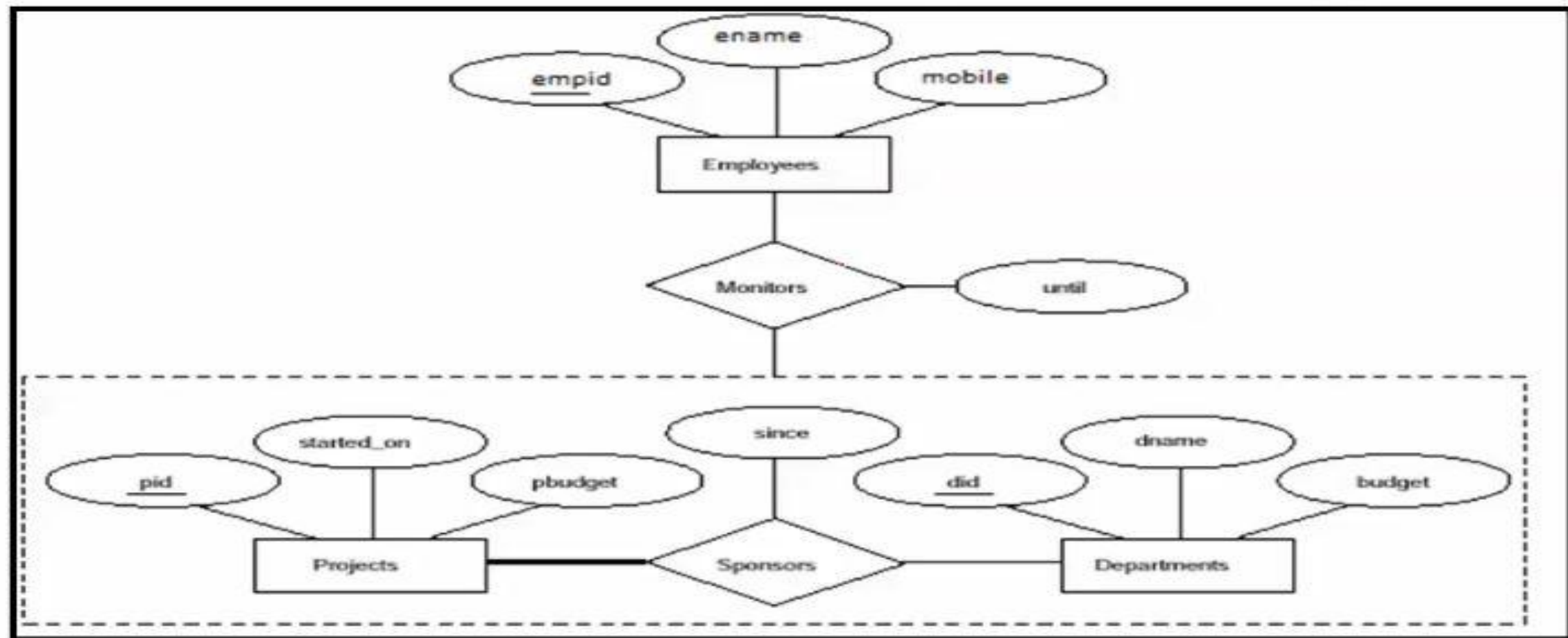
EMP

Contract_EMP & Senior_Emp
doesn't **Cover** EMP

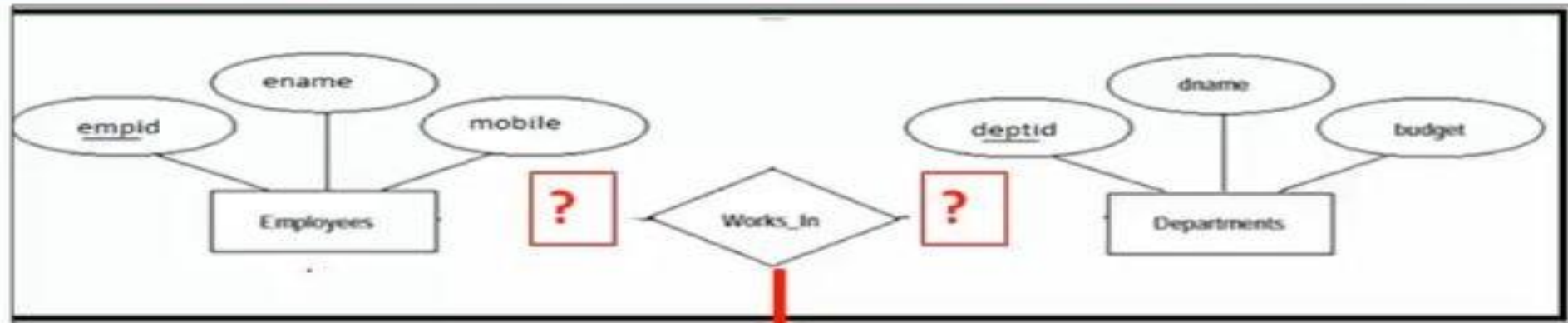
E-R Diagram Notations & Options

AGGREGATION

Aggregation allows us to indicate that a relationship set (identified through a dashed box) participates in another relationship set. This is illustrated with a dashed box around Sponsors (and its participating entity sets) used to denote aggregation.



Identifying TABLES from the E-R Diagram



POSSIBLE CARDINALITIES for a Relationship Set

- 1 $N:N$ → Total Tables = 3 [EMP, DEPT, WORKS_IN]
- 2 $1:N$ → Total Tables = 2 [EMP, DEPT]
- 3 $N:1$ → Total Tables = 2 [EMP, DEPT]
- 4 $1:1$ → Total Tables = 2 [EMP, DEPT]

Identifying TABLES from the E-R Diagram

IMPORTANT TIPS

1

Every Attribute of the Entity will become the Column of the table

2

Mostly every Entity in the E-R Diagram will become a TABLE in Relational Model

3

The Relationship Set with NO CONSTRAINTS will become a TABLE

4

The Relationship Set with CONSTRAINTS may (or) may not become a TABLE

5

We have to be careful in identifying the Constraints [Business Rules]

6

If Relationship Set is not a table, then descriptive attributes of the relationship will move to either of the Entities involved in the relation

Relationship Set with NO CONSTRAINTS

Business Rule :1

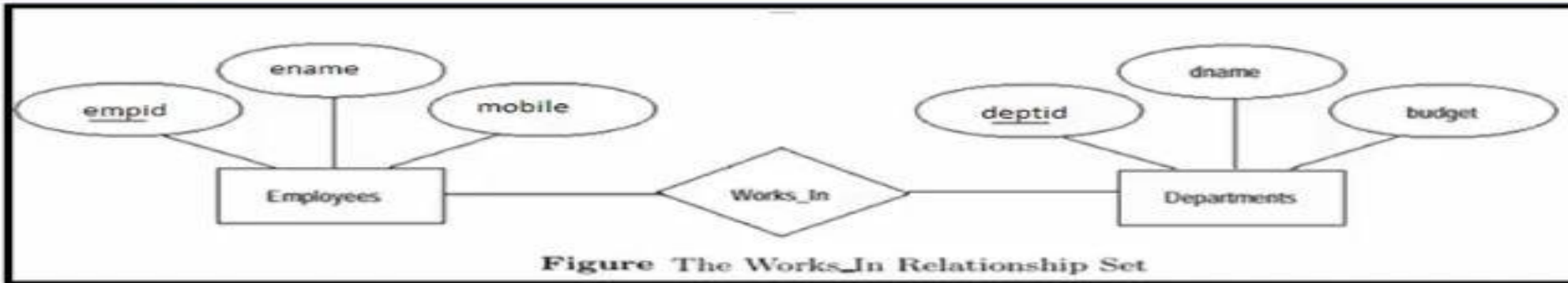
An employee can work for multiple departments

$(\min, \max) = (0, n)$

Business Rule :2

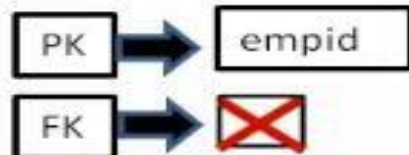
Department can have multiple employees

$(\min, \max) = (0, n)$



Free Employees & Free Departments are Allowed as per the Business Rules

EMP		
empid	ename	mobile
1	prakash	9866474747
2	navatha	9390373737
3	Pranavi	9849333355



Total Tables = 3

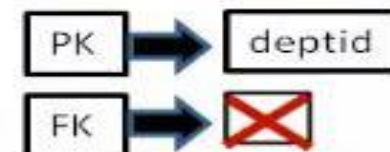
WORKS_IN

empid	deptid
1	101
1	102
2	101



DEPT

deptid	dname	Budget
101	MCA	200
102	MBA	300
103	MSC	500



Relationship with KEY CONSTRAINT [Left Side of Relation]

Business Rule :1



An employee can work in at most one department

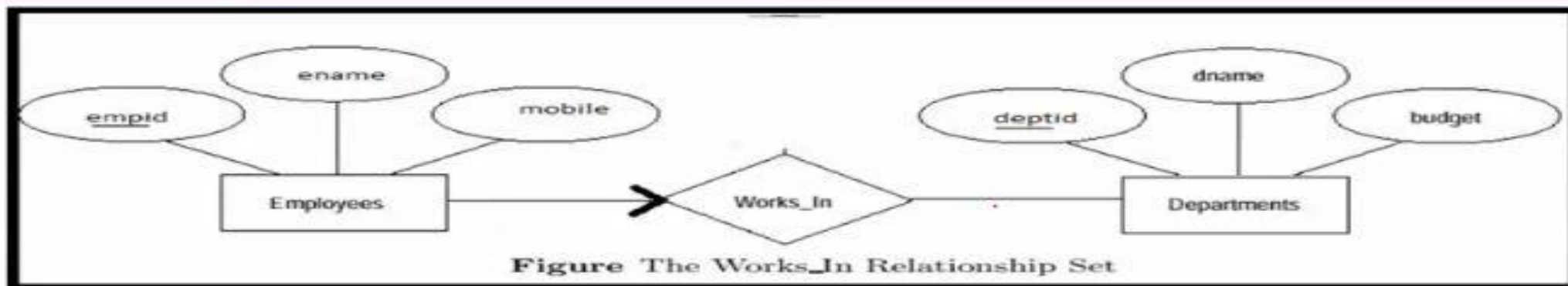
(0, 1)

Business Rule :2



Department can have multiple employees

(0, n)



Free Employees & Free Departments are Allowed as per the Business Rules

EMP

empid	ename	mobile	deptid
1	prakash	9866474747	101
2	navatha	9390373737	NULL
3	Pranavi	9849333355	NULL

PK → empid

FK → deptid → DEPT(deptid)

Can deptid of EMP accepts NULL Values ?

YES

Total Tables =

2

DEPT

deptid	dname	Budget
101	MCA	200
102	MBA	300
103	MSC	500

PK → deptid

FK →



Relationship with KEY CONSTRAINT & PARTICIPATION CONSTRAINT [Left Side of the Relation]

Business Rule :1



An employee must work and at most one department

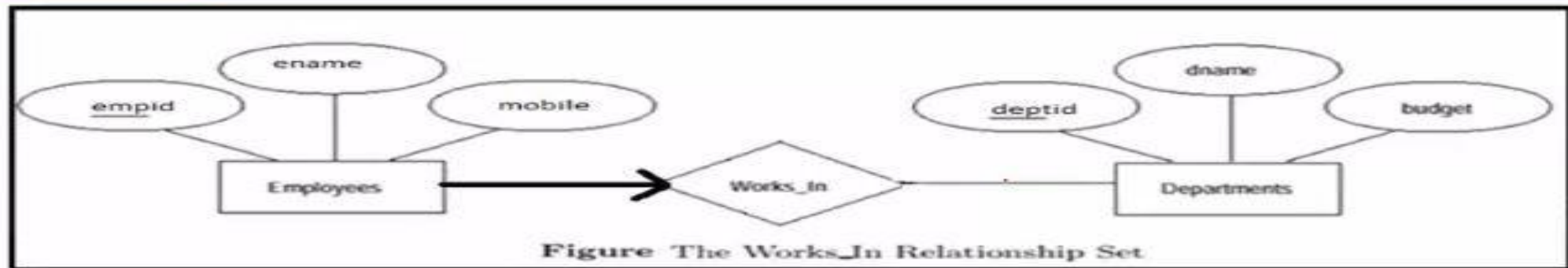
(1, 1)

Business Rule :2



Department can have multiple employees

(0, n)



Free Employees are NOT Allowed as per the Business Rule

EMP

empid	ename	mobile	deptid
1	prakash	9866474747	101
2	navatha	9390373737	101

Total Tables

=

2

DEPT

deptid	dname	Budget
101	MCA	200
102	MBA	300
103	MSC	500

PK → empid

FK → deptid → DEPT(deptid)

+ NOT NULL condition

Can deptid of EMP accepts NULL Values ?

NO

PK → deptid

FK → ❌

Relationship with KEY CONSTRAINT [Right Side of Relation]

Business Rule :1

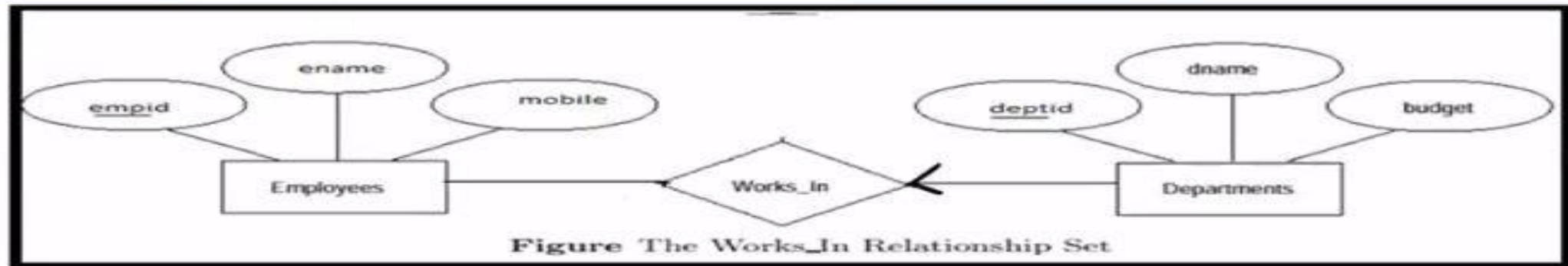
An employee can work in multiple departments

(0, n)

Business Rule :2

A Department can have at most one employee

(0, 1)



Free Employees & Free Departments are Allowed as per the Business Rules

EMP

Total Tables = 2

DEPT

Empid	ename	mobile
1	prakash	9866474747
2	navatha	9390373737

deptid	dname	Budget	empid
101	MCA	200	1
102	MBA	300	1
103	MSC	500	NULL



Can empid of DEPT accepts NULL Values ?

YES



Relationship with KEY CONSTRAINT & PARTICIPATION CONSTRAINT [Right Side of Relation]

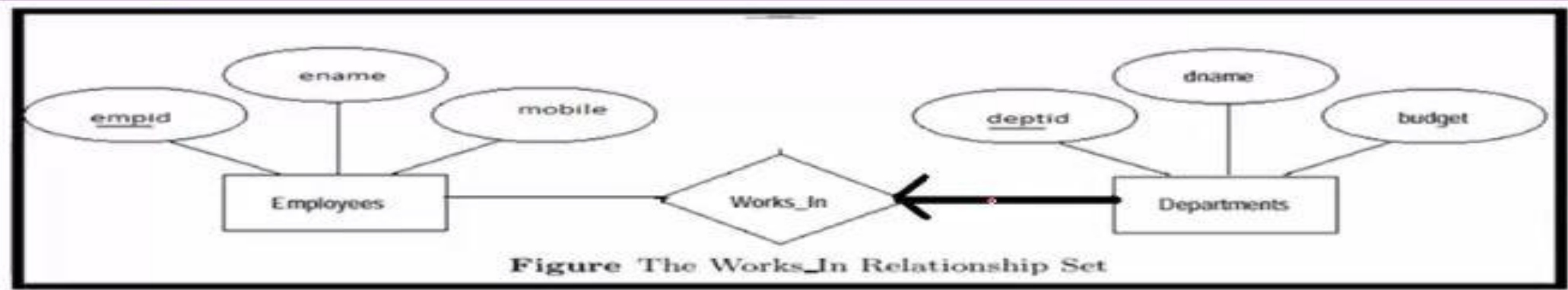
- Business Rule :1

An employee can work in multiple departments

(0 , n)
- Business Rule :2

A Department must have only one employee

(1 , 1)



Free Departments are NOT Allowed as per the Business Rules

Empid	ename	mobile	deptid	dname	Budget	empid
1	prakash	9866474747	101	MCA	200	1
2	navatha	9390373737	102	MBA	300	1
			103	MSC	500	1

PK

empid

FK

Can empid of DEPT accepts NULL Values ?

NO

PK

deptid

FK

empid → EMP(empid)

+

NOT NULL condition

Relationship with KEY CONSTRAINT [On Both Sides of the Relation]

Business Rule :1



An employee can work in at most one department

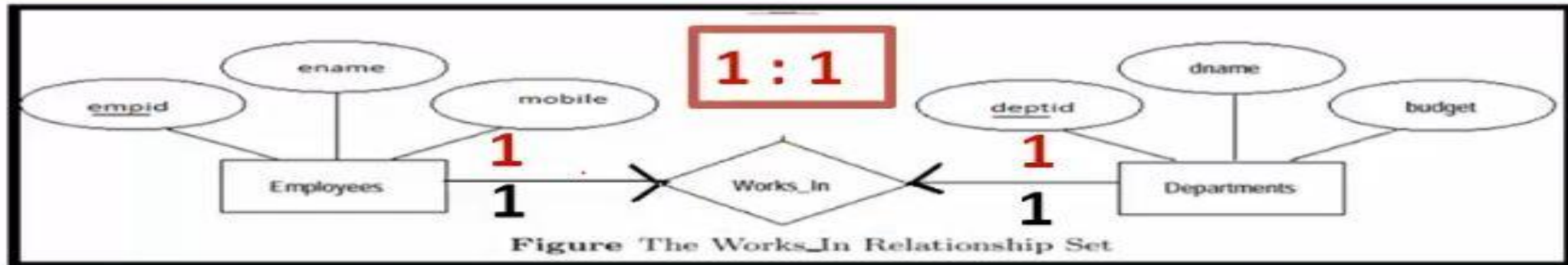
(0, 1)

Business Rule :2



A Department can have at most one employee

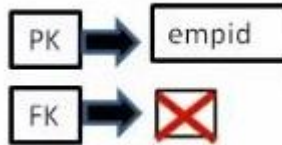
(0, 1)



Free Employees & Free Departments are Allowed

EMP

Empid	ename	mobile
1	prakash	9866474747
2	navatha	9390373737



Total Tables

=

2

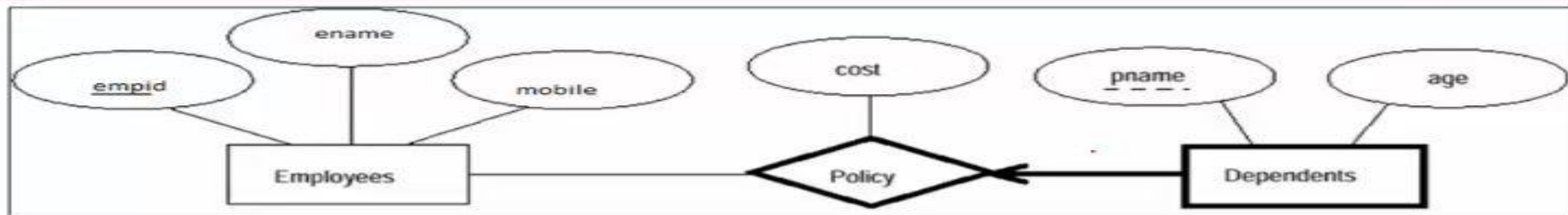
DEPT

deptid	dname	Budget	empid
101	MCA	200	1
102	MBA	500	NULL



Weak Entity

“A weak entity set always participates in a **one-to-many** binary relationship and has a **key constraint** and **total participation**.”



Entity **without Key Attribute** is called Weak Entity

Free DEPENDENTS are NOT Allowed as per the Business Rule

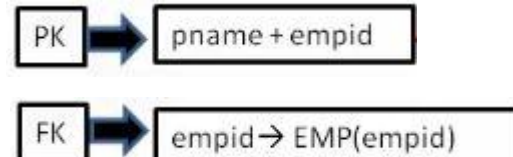
EMP

empid	ename	mobile
1	prakash	9866474747
2	navatha	9390373737



DEPENDENT_POLICY

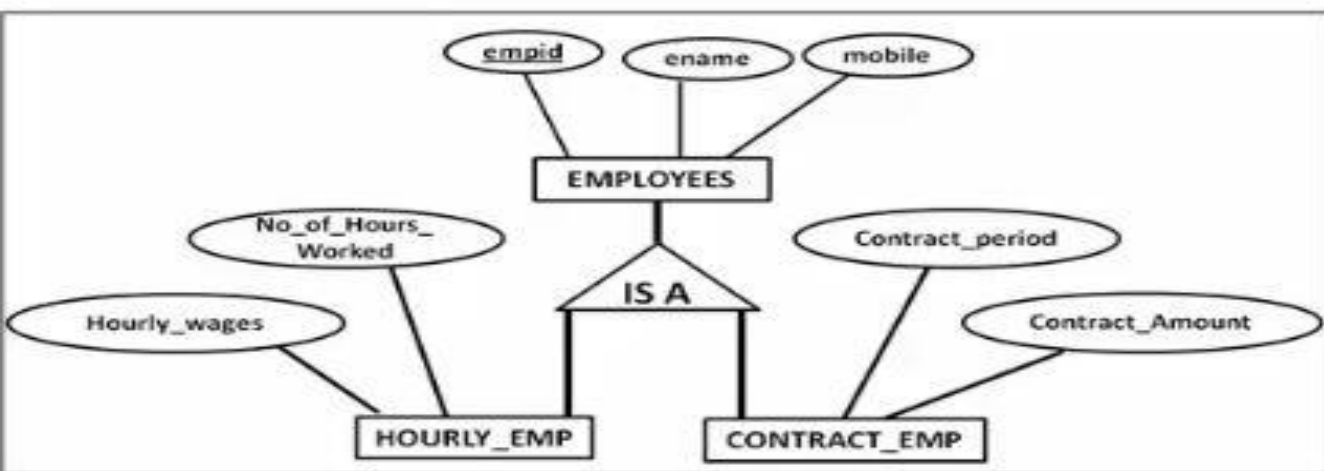
pname	age	empid	cost
pranavi	3	1	30000
pranavi	3	1	55555



Translating E-R Diagram with CLASS HIERARCHIES

EMP

empid	ename	Mobile
1	a	9999999999
2	b	8888888888
3	c	7777777777
4	d	6666666666



Total Tables = 3

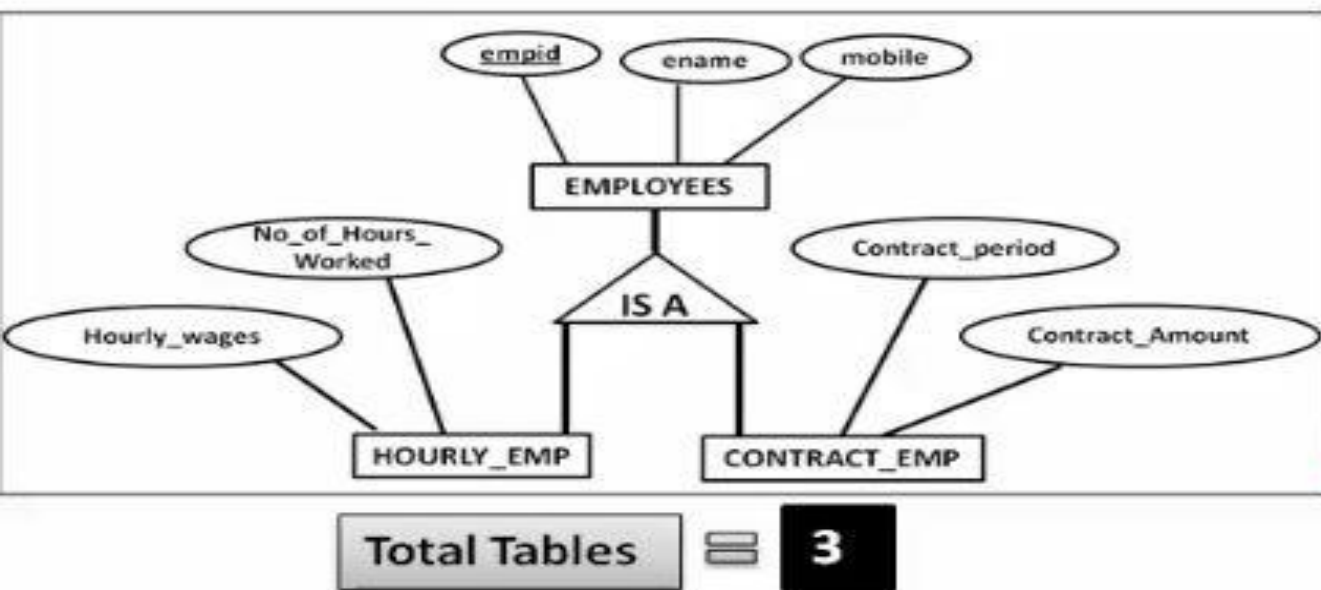
HOURLY_EMP

empid	hourly_wages	hours_worked
2	300	444
4	550	284

CONTRACT_EMP

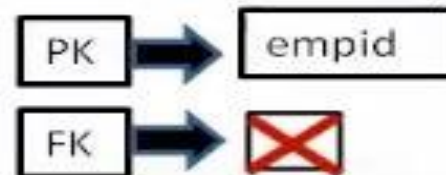
empid	Contract_period	Contract_Amount
1	6months	6 lakhs
3	10 months	8 lakhs

Translating E-R Diagram with CLASS HIERARCHIES



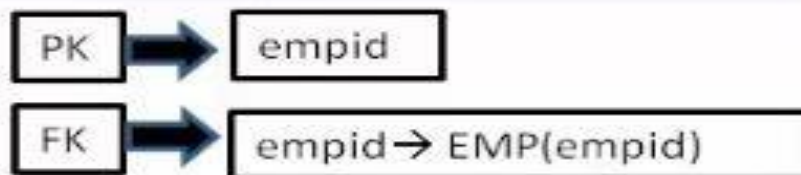
EMP

empid	ename	Mobile
1	a	9999999999
2	b	8888888888
3	c	7777777777
4	d	6666666666



HOURLY_EMP

empid	hourly_wages	hours_worked
2	300	444
4	550	284

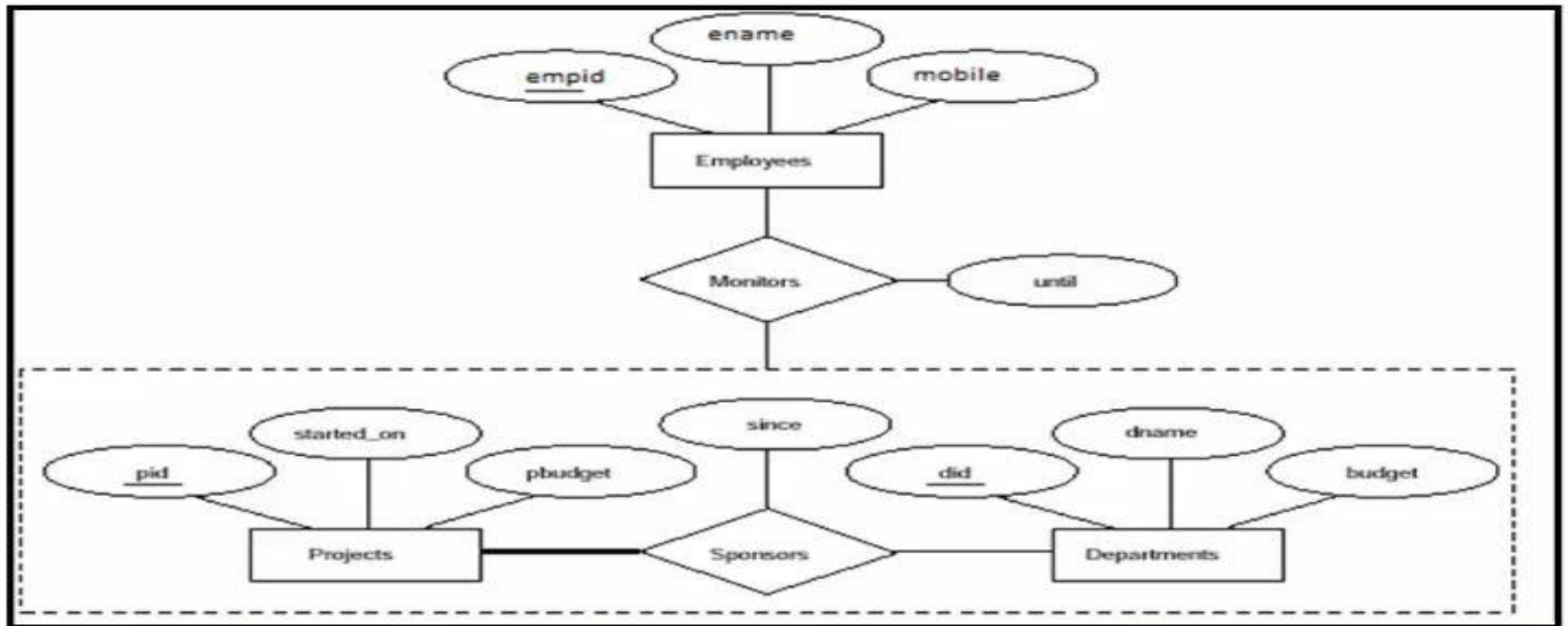


CONTRACT_EMP

empid	Contract_period	Contract_Amount
1	6months	6 lakhs
3	10 months	8 lakhs



Translating E-R Diagram with AGGREGATION



Total Tables = **5**

- 1) Projects
- 2) Departments
- 3) Sponsors
- 4) Employees
- 5) Monitors**

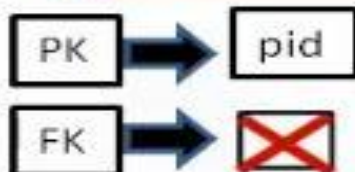
Translating E-R Diagram with AGGREGATION

Total Tables = 5

- 1) Projects
- 2) Departments
- 3) Sponsors
- 4) Employees
- 5) **Monitors**

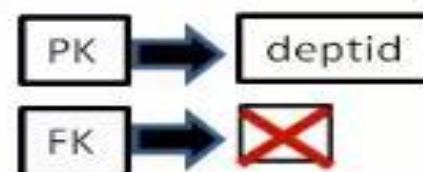
PROJECTS

pid	started_on	pbudget
P111	11-07-12	333
P222	20-08-11	444



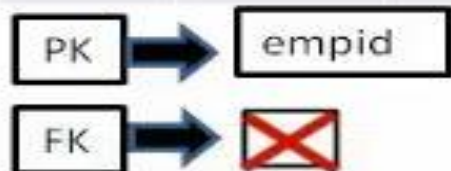
DEPT

deptid	dname	Budget
101	MCA	200
102	MBA	300



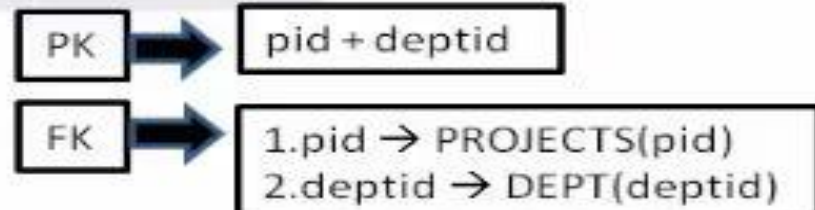
EMP

empid	ename	mobile
1	prakash	9866474747
2	navatha	9390373737



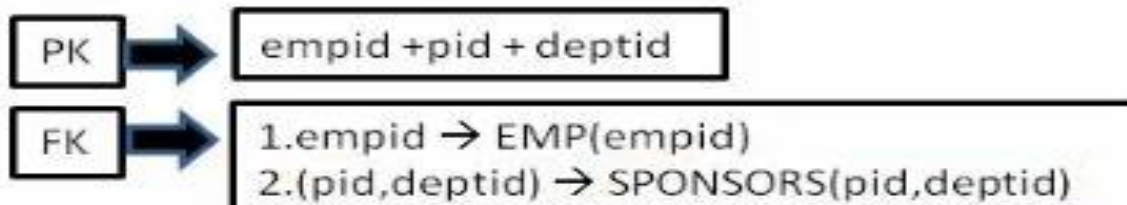
SPONSORS

pid	deptid	since
P111	101	11-07-12
P222	102	20-08-11



MONITORS

empid	pid	deptid	until
1	P11	101	14-09-14
2	P222	102	11-02-17



GATE Previous Questions

Let E_1 and E_2 be 2 entities in an E-R diagram with simple single-valued attributes.

R_1 and R_2 are 2 relationships between E_1 and E_2 , Where R_1 is **one-to-many** and R_2 is **many-to-many**.

R_1 and R_2 don't have any attributes of their own.

What are the **minimum no of tables** required to represent this situation in the relational model?

- a. 2
- b. 3
- c. 4
- d. 5

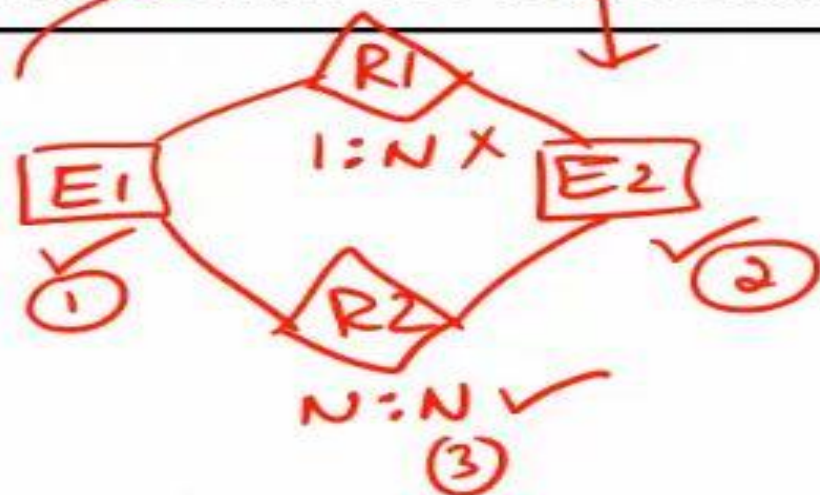
GATE Previous Questions

Let $\underline{E_1}$ and $\underline{E_2}$ be 2 entities in an E-R diagram with simple single-valued attributes.

R_1 and R_2 are 2 relationships between E_1 and E_2 , Where R_1 is one-to-many and R_2 is many-to-many.

R_1 and R_2 don't have any attributes of their own.

What are the minimum no of tables required to represent this situation in the relational model?



a. 2

b. 3 ✓

c. 4

d. 5

= $E_1, E_2, R_2 \rightarrow N:N$

In an entity relationship,

‘Y’ is the **dominant entity** and

‘X’ is the **subordinate entity**.

Which of the following are incorrect?

- a. Operationally, ‘X’ is deleted, ‘Y’ remains same
- b. Operationally, ‘X’ is deleted, so is ‘Y’
- c. Operationally, ‘Y’ is deleted, so is ‘X’
- d. ‘X’ is existence dependent on ‘Y’

GATE Previous Questions

In an entity relationship,

'Y' is the **dominant entity** and

'X' is the **subordinate entity**.

✓ Y → EMP (strong entity)
✗ X → dependant (weak)

Which of the following are incorrect?

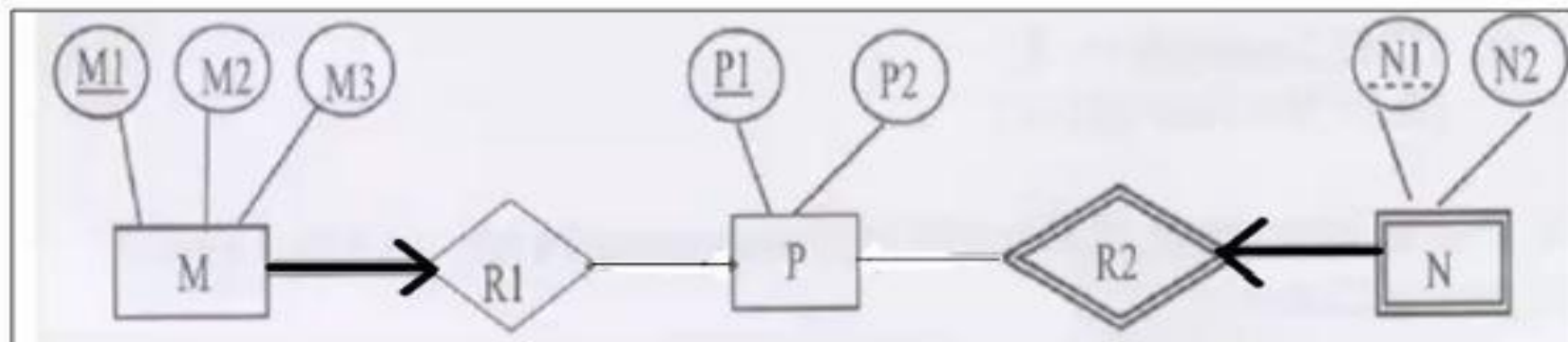
a. ✓ Operationally, X is deleted, Y remains same

b. ✗ Operationally, X is deleted, so is Y

c. ✓ Operationally, 'Y' is deleted, so is 'X'

d. ✓ 'X' is existence dependent on 'Y'

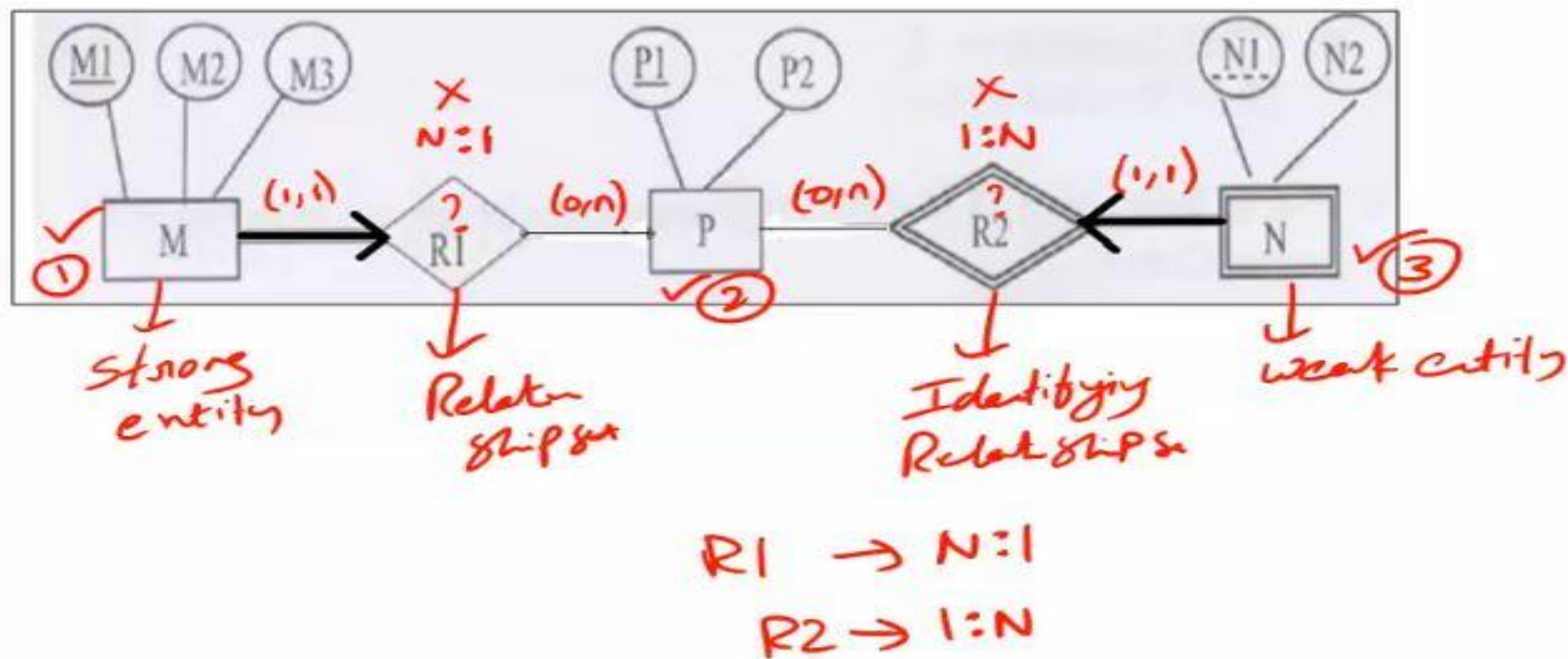
Consider the following E-R diagram:-



The minimum number of tables needed to represent M, N, P, R1, R2 are:-

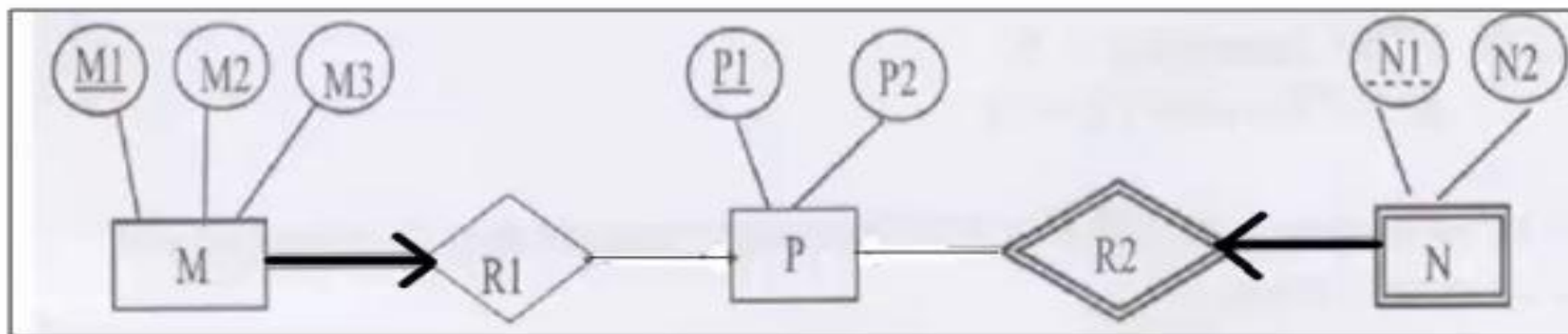
- a. 2
- b. 3
- c. 4
- d. 5

Consider the following E-R diagram:-



The minimum number of tables needed to represent M, N, P, R1, R2 are:-

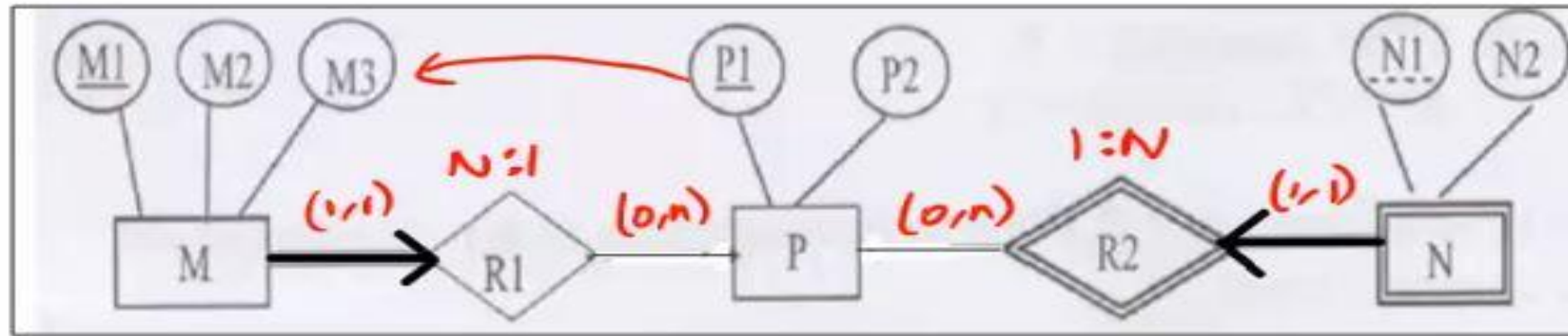
- a. 2
- b. 3** ✓
- c. 4
- d. 5



Which of the following is a correct attribute set for one of the tables for the correct answer to the above question?

- a. {M1, M2, M3, P1}
- b. {M1, P1, N1, N2}
- c. {M1, P1, N1}
- d. {M1, P1}

- ① $M = (\underline{M1}, M2, M3, P1)$
- ② $P = (\underline{P1}, P2)$
- ③ $N = (\underline{N1}, P1, N2)$



Which of the following is a **correct attribute set** for one of the tables for the correct answer to the above question?

- a. {M1, M2, M3, P1} ✓
- b. {M1, P1, N1, N2} ✗
- c. {M1, P1, N1} ✗
- d. {M1, P1} ✗

GATE Previous Questions

Consider the entities “**hotel room**” and “**person**” with a many-to-many relationship “**lodging**” between the entities.

If we wish to store information about the “**rent payment**” to be made by person occupying different hotel rooms, then this information should appear as an attribute of

- a. Person
- b. Hotel Room
- c. Lodging
- d. None

GATE Previous Questions

Consider the entities “hotel room” and “person” with a many-to-many relationship “lodging” between the entities.

If we wish to store information about the “**rent payment**” to be made by person occupying different hotel rooms, then this information should appear as an attribute of PI Paid 400\$ for renting Room 306

- a. Person
- b. Hotel Room
- c. Lodging
- d. None

