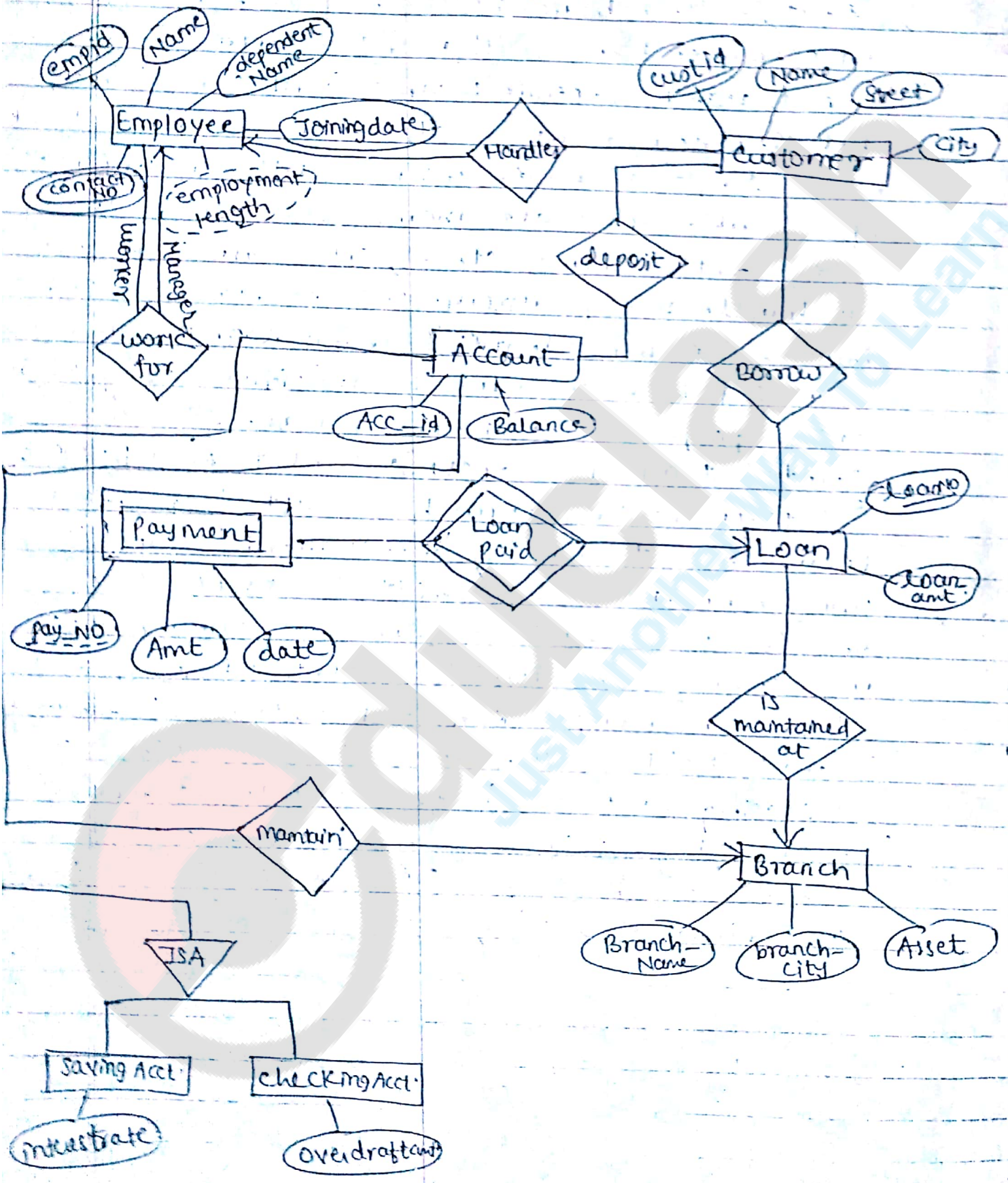
DBMS

ER-Diagram

1) ABCD limited bank has no. of employees, for an employee bank will maintain details like empid, name, dependent name, contactno, joining date & employment length. Several employee work under single manager, who is also an employee of a bank. Bank also maintains customer details like custId, Name, street, city. One employee can handle many customers. Customers of Bank borrow the loan identified using loan no, amount. Loan is paid in installment identified using payment no, payment Amt, payment date. If loan is deleted than bank does not need to keep track of its payment. One loan has multiple payment. Loan is maintained by branch which is identified using branchname, branchcity & asset. One branch can handle many loans. Customer deposit amt into account which is identified using accid & balance. Many account is maintained by 1 branch. Account is either saving account or checking account, On saving acct customer get interest rate & on checking acct customer get Overdraft amt.

payment = weak entity

Draw an ER-diagram for ABCD limited bank that capture above rqmnt.



Not Null → Missing values & Not Applicable (3)

2) Patients are identified by an SSN, & their names, addresses, & ages must be recorded. Doctors are identified by an SSN. For each doctor, the name, specialty, & years of experience must be recorded. Each pharmaceutical company is identified by name & has a phone number. For each drug, the trade name & formula must be recorded. Each drug is made by a given pharmaceutical company, & the trade name identifies a drug uniquely from among the products of that company. If a pharmaceutical company is deleted, you need not keep track of its products any longer. Each pharmacy has a name, address & phone number. Every patient has a primary physician; a doctor & every doctor has at least one patient. Each pharmacy sells several drugs & has a price for each. A drug could be sold at several pharmacies, & the price could vary from one pharmacy to another. Doctors prescribe drugs for patients. A doctor could prescribe one or more drugs for several patients, & a patient could obtain prescriptn from several doctors. Each prescriptn has a date & a quantity associated with it. Phar. Companies have long-term contracts with pharmacies. A phar. company can contract with several pharmacies, & a pharmacy can contract with several phar. companies. For each contract you have to store a start date, an end date, & the text of the contract & Supervisor for each contract appointed by pharmacies. Draw an ER-diagram that captures the preceding infon.

F+ → closure

FD (Functional Dependency)

* Armstrong Axioms / Inference rules

1) Reflexivity
   X → Y i.e X is superset of Y or Y is subset of X

2) Augmentation
   If X → Y then XZ → YZ.

3) Transitivity
   If X → Y & Y → Z then X → Z.

4) Union
   If X → Y & X → Z then X → YZ

5) Decomposition
   If X → YZ then X → Y & X → Z
   eg:- {Mngr_id} → {Mngr_Name, Mngr_age}
   then
   {Mngr_id} → {Mngr_name}
   {Mngr_id} → {Mngr_age}

Ques
eg:- Let us consider schema r with attributes ABCDEF.
The given sets of functional dependencies are
A → BC
B → E
CD → EF

- what are the other FD that can be generated from F? Find out F+ or Closure.
- Also show that the FD A → E can be derived from above set of FD.

Ans:- $A \to BC$ } ... Given.

decomposition { $A \to B$, $A \to C$ } $A \to E$ ... transitivity

Given ... $B \to E$

$CD \to F$

$CD \to F$

Augmentation { $A \to C$, $AD \to CD$, $CD \to E$ } $AD \to E$

2) Given the relatn schema R(A, B, C, D, E) and the foll. set F of fnal dependencies

$A \to BC$

$CD \to E$

$B \to D$

$E \to A$

List the candidate keys for R.

Ans:- $A \to BC \Rightarrow A \to B$ & $A \to C$

$A \to B \wedge B \to D \Rightarrow A \to D$

$A \to CD \wedge CD \to E \Rightarrow A \to E$

$A \to A$ then $A \to ABCDE$ ⟵ A is a candidate key

$E \to A$ then $E \to ABCDE$ ⟵ E is a candidate key

~~$CD \to E$~~

$CD \leftarrow E$ then $CD \leftarrow ABCDE$ ⟵ CD is a candidate key

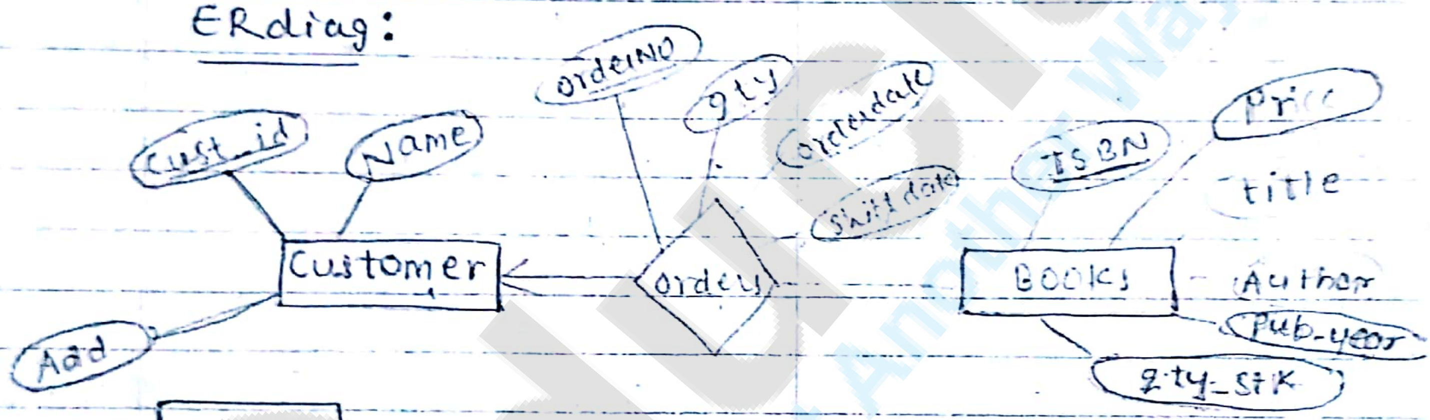
one ← or one —|—
many = many —||—

* Normalization

20 marks Q1) Bookshop maintains details of Customer & Books. Customers are identified using cust_id, cust_name, Address. Books are identified using ISBN, title, Author, qty_in_stock, price & publishing_year. Customer can order many books in single order, for each order bookshop maintain order no, qty, orderdate, shiftdate. Draw an ER diagram that capture above infoⁿ & convert them into relational schema, Also normalize relatⁿal schema upto 3NF.

Solⁿ:-

ERdiag:



Schema:

Customer (Cust_id : integer, Name : varchar(20), Add : varchar(30));

BOOKS (ISBN : integer, price : varchar(10), title : varchar(20), Author : varchar(30), pub_year : integer, qty_stk : integer);

Orders (orderNO : integer, qty : integer, orderdate : date, shiftdate : date, Cust_id : integer, ISBN : integer, primary key (orderNo, ISBN));

3NF -> NO FD, all attributes depend on 1 key.

Normalization :

In BOOKs relation schema only 1 attribute ISBN (Key) determine all other attributes & no other FD hold over table. So, BOOKs relation schema is in 3NF.

Customer table has only 1 key Cust_id & no other FD hold over table, so the customer is also in 3NF.

For Orders Schema
{orderNo, ISBN} is the key
The other FD's are are as follows :
{order_NO} → {cust_id}
{orderNO} → {order_date}
{order_NO, ISBN} → {Qty}
{order_NO, ISBN} → {shift_date}

In above FD Cust_id & order_date is partially depend on key. So, orders schema is not in 2NF.
Thus 2NF is:
order_info (order_NO : integer, CustId : integer, Order_date : integer) ; (date)
(All partial dependent in)

order_master (order_NO : intger, ISBN : integer, Qty : integer, shift_date : date) ;
(fully)

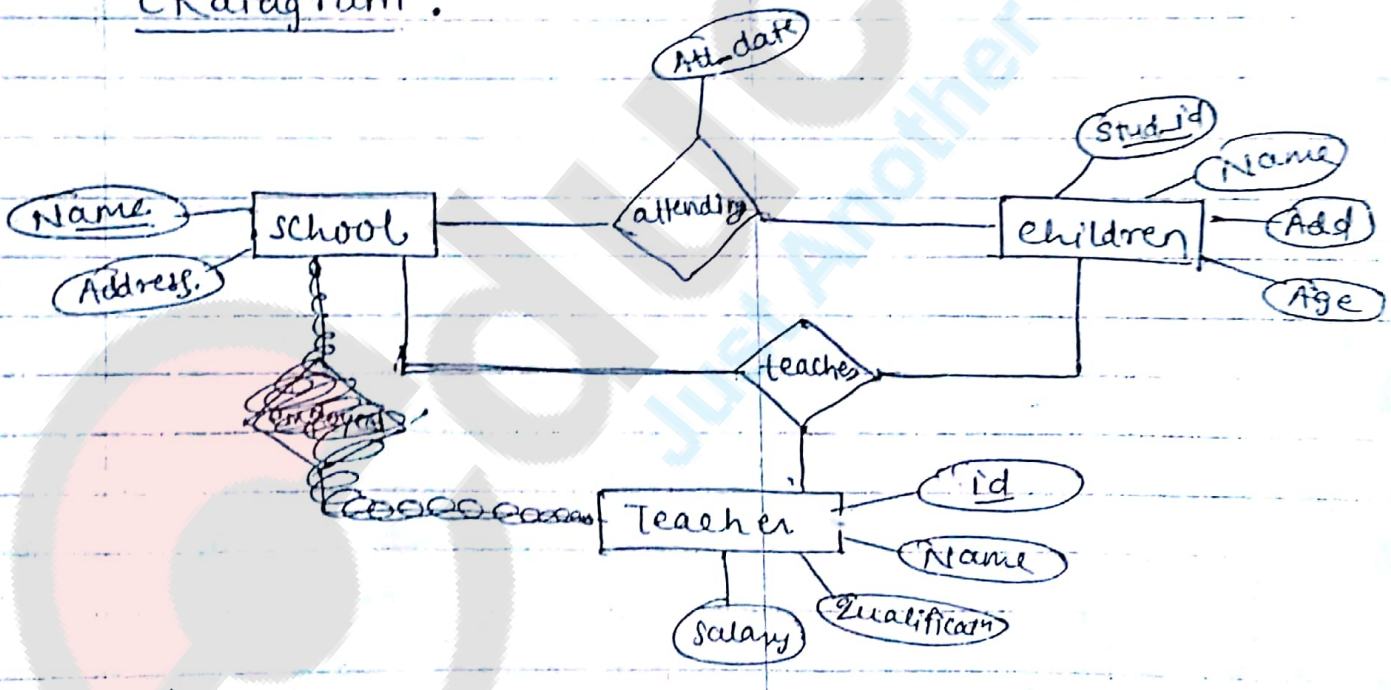
Q2) A Local authority wish to keep a database of all its school & the school children that are attending its school. The system shd also be able to record teacher available to be employeed at a school & be able to show which teacher teach ~~with~~ which children & in which school. Each school has one head teacher whose responsibility is to manage their individual school.

(a) Construct an ER diagram for the above school system. Document all assumptions that you make for designing.

(b) write schema defn & normalize all tables to 3NF for above ER diagram.

Ans:-

ER diagram :



Schema :

School (Name : varchar2(20), Address : varchar2(100));

Children (Studid : number, Name : varchar2(20), Add : varchar2(20), Age : Number);

(10)

Teacher (id: number, Name: varchar2(20), Qualification: varchar2(20), Salary (number));

a	b	c
1	2	3
4	2	5

a	b
1	2
4	2

c	b
3	2
5	2

FD = { a → b, c → b }

a	b	c
1	2	3
1	2	5
4	2	3
4	2	5

a	b	c
1	2	3
1	2	5
4	2	3
4	2	5

* Lossless decomposition

② R(a, b, c)
R1(a, c)
R2(c, b)

① R(a, b, c)
R1(a, b)
R2(b, c)

① Ans

a	b
1	2
4	2

b	c
2	3
2	5

② Ans

a	c
1	3
4	5

c	b
3	2
5	2

a	b	b	c
1	2	2	3
1	2	2	5
4	2	2	3
4	2	2	5

a	b	c
1	2	3
1	2	5
4	2	3
4	2	5

∴ Lossy

a	c	c	b
1	3	3	2 ✓
1	5	5	2 ✗
4	5	3	2 ✗
4	5	5	2 ✓

a	b	c
1	2	3
4	2	5

It matches with original table ∴ Lossless

If anything is lost or if anything comes extra then it is Lossy

* Dependency preserving

R(A, B, C) with A → B, B → C & C → A which is decomposed into R1(A B) & R2(B C)

i) Is this decomposition is dependency preserving?
ii) Is C → A preserved?

Ans:- F* a → b b → c c → A
F+ a → c b → a c → b

R1(A B) = a → b, b → a
R2(B C) = b → c, c → b

(FR1 ∪ FR2)+ = c → b, b → a
∴ c → a

Hence, C → A is preserved.

a → b, b → a
b → c, c → b, c → a, a → c

Now, a → b
b → c

i.e (FR1 ∪ FR2)+ = F+.

a → b, b → a,
b → c, c → b,
c → a, a → c

a → b b → c
c → a a → c
b → a c → b

Hence it is dependency preserving.

(13) F = Set of FD's F+ → closure (what you get after decomposing F by using armstrong axioms)

G = Minimal cover for F

* Minimal cover for a set of FD

1) Let F be the set of dependencies:
$A \to B$, $ABCD \to E$, $EF \to G$, $EF \to H$, $ACDF \to EG$.

→ put F in standard form (i.e only single attribute on right side)

$ACDF \to EG$

$\therefore ACDF \to E$, $ACDF \to G$

Next consider, $ABCD \to E$. Since $A \to B$ holds, we can replace $ACD \to E$.

Thus a minimal cover for F is the set:

$A \to B$, $ACD \to E$, $EF \to G$, $EF \to H$.

Next consider, $ACDF \to G$. This dependency is implied by foll. FD's:

$A \to B$, $ABCD \to E$, $EF \to G$

$A \to B$

$ACD \to E$

$\therefore ACDF \to EF$

$EF \to G$

$\therefore ACDF \to G$.

Therefore, we can delete it.

Similarly we can delete $ACDF \to E$.

bcoz ~~$A \to B$~~ $ABCD \to E$, $A \to B$

~~$ABCDF$ Now, $ACDE$~~

$\therefore ACD \to E$

So, $ACDF \to EF$ (Augmentation)

$\therefore ACDF \to E$

$ACDF \to F$

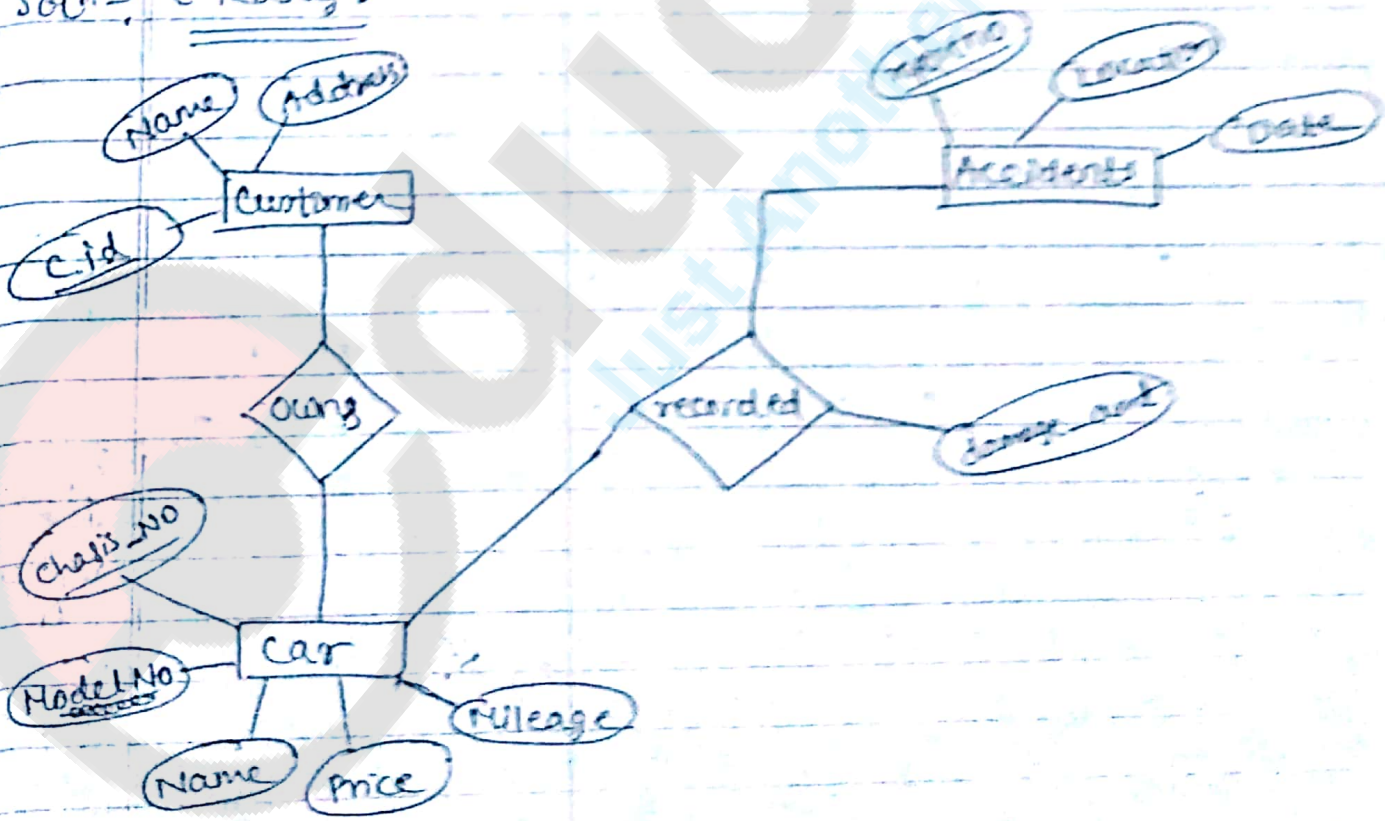
Thus, we can delete $ACDF \to E$.

Thus, a minimal cover for F is the set:

$\therefore G = A \to B$, $ACD \to E$, $EF \to G$, $EF \to H$

Q) Construct all ER diagram for a car insurance company whose customer own one or more cars each. Each car has associated with it 0 to any no. of recorded accidents. Accidents are identified using report no, location & date for recorded accidents damage amount is also maintain. Construct appropriate relational schema for the car insurance company.

SOLN :- E·R diag :



schema :

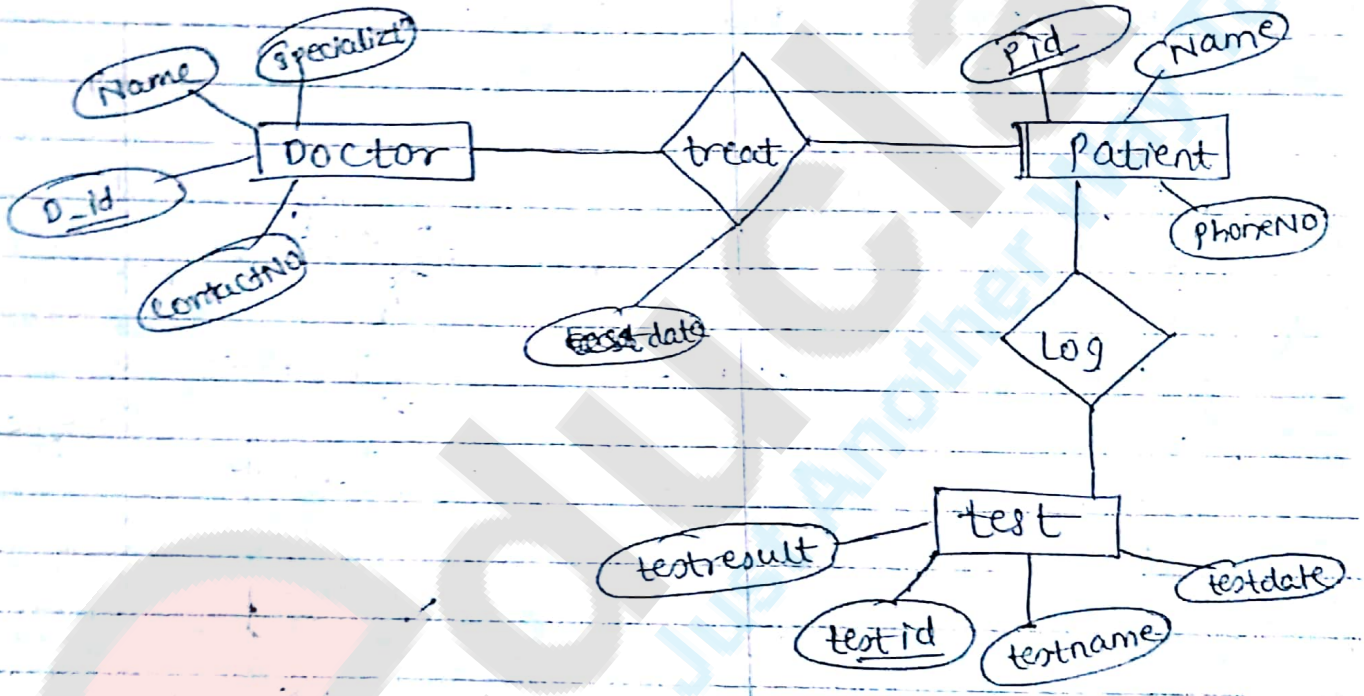
1) Customer (cid, Name, Address);

4) owns (cid, chasisNO);

5) recorded (reportno, chasisNO, damage_amt);

Q) construct an ER diagram for a hospital with a set of patients & set of medical doctors. Doctor treat patient & associate each patient a log of various test conducted. construct appropriate relational schema for the hospital.

Ans:- ER diag:



Schema:

1) Doctor (D_id, Name, specialization, contactNO);

2) patient (P_id, Name, phoneNO);

3) treat (D_id, P_id, date);

4) test (testid, testname, testdate, testresult);

5) Log (P_id, test id);

Q) A University registrar office maintain data about foll. entities:

(a) courses, including number, title, credit, syllabus.

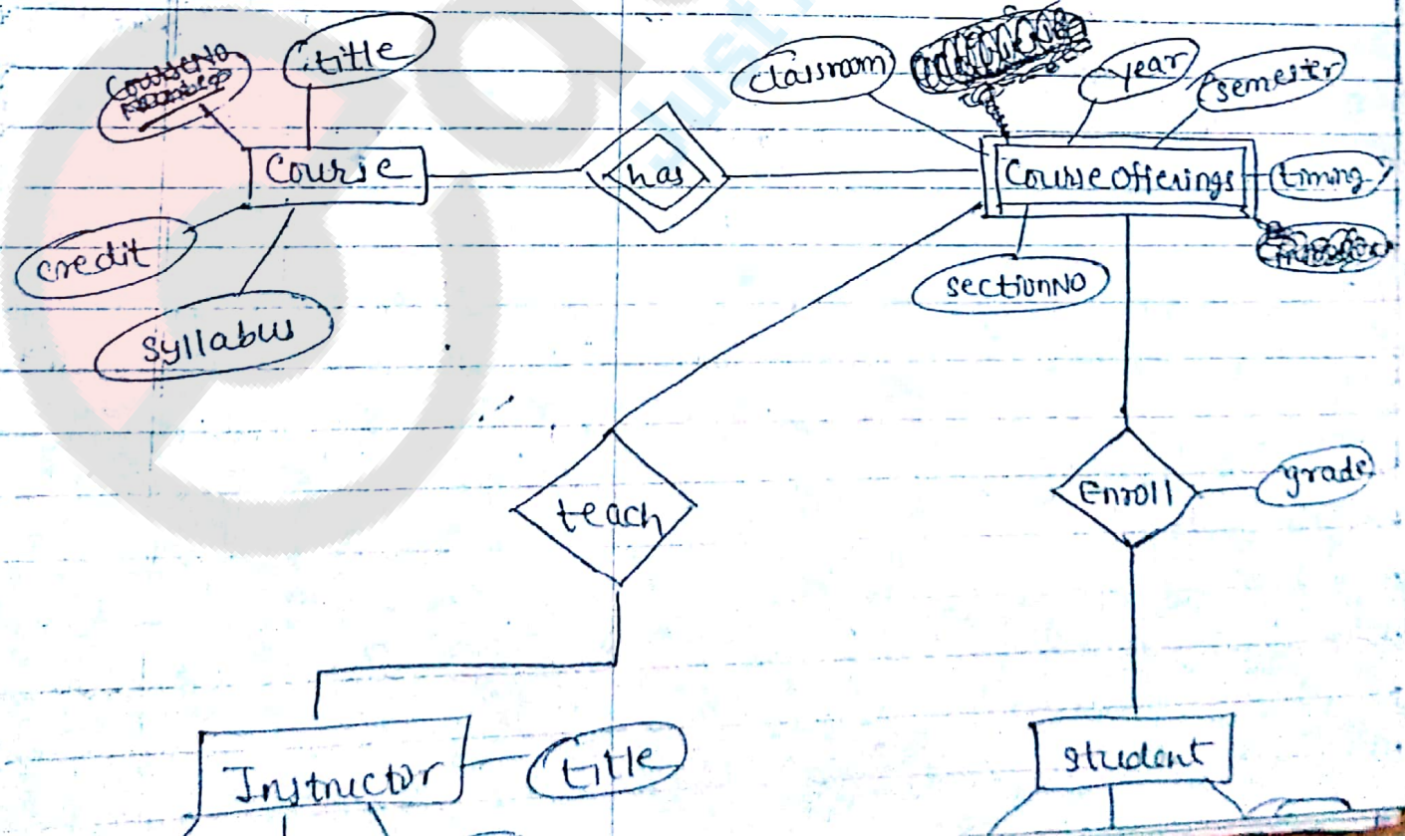
(b) course offerings, including courseno, year, semester, sectionNO, instructor, timing, classroom.

(c) student including studentid, name, program.

(d) Instructor including identificationno, name, dept, title.

Further the enrollment of student in courses & grade awarded to students in each course they are enrolled for must be appropriately modelled. Construct an ER diagram for registrar's office.

Ans:- ER diag:



(17) has → weak entity relation
∴ don't create it schema

Schema :

1) Course (courseNO, title, credit, syllabus);

2) courseofferings (courseNO, year, semester, sectionNO, classroom, timing);

3) has (courseNO, year, semester, sectionNO);

4) Student (Stud id, Name, program);

5) enroll (studid, courseNO, year, semester, sectionNO, grade);

6) Instructor (idNO, Name, dept, title)

7) teach (idNO, courseNO, year, semester, sectionNO);

Q) Consider relational schema R(A, B, C, D, E, F) with foll: functional dependency
A → C, C → D, D → B, E → F
Find the candidate Key for R.

Ans: A → C & C → D ∴ A → D
C → D & D → B ∴ C → B
A → D & D → B ∴ A → B

~~A → AC D B~~ A → C D B
~~C → C D B~~ C → D B
~~E → E F~~ E → F

$(AB)^+ \rightarrow ABCD$
$(AC)^+ \rightarrow ACDB$
$(AD)^+ \rightarrow ACDB$
$(AE)^+ \rightarrow ABCDEF$ ∴ AE is a candidate key.
$(AF)^+ \rightarrow ABCDF$

∴ AE is a candidate key.

Q2) Consider set R with FD R(A, B, C, D, E, F, G, H)
$AB \rightarrow C$
$A \rightarrow DE$
$B \rightarrow F$
$F \rightarrow GH$ Find the candidate key for R.

Ans: $AB \rightarrow C$
$A \rightarrow DE$ ∴ $A \rightarrow D$, $A \rightarrow E$
$F \rightarrow GH$ ∴ $F \rightarrow G$, $F \rightarrow H$
$B \rightarrow F$ & $F \rightarrow GH$ ∴ $B \rightarrow GH$ i.e $B \rightarrow G$ & $B \rightarrow H$
∴ $B \rightarrow FGH$

$(AB)^+ \rightarrow ABDEFGH$
$(AC)^+ \rightarrow ADEC$
$(BC)^+ \rightarrow BFGHC$
$(BD)^+ \rightarrow BFGHD$
$(BE)^+ \rightarrow FGHBE$
$(BF)^+ \rightarrow BFGH$
$(BG)^+ \rightarrow BFGH$

$(AD)^+ \rightarrow ADE$
$(AE)^+ \rightarrow ADE$
$(AF)^+ \rightarrow ADEFGH$
$(AG)^+ \rightarrow ADEG$
$(AH)^+ \rightarrow ADEH$

$(CD)^+ \rightarrow CD$

$(CE)^+ \rightarrow CE$

$(CF)^+ \rightarrow CGHF$

$(CG)^+ \rightarrow CG$

$(CH)^+ \rightarrow CH$

$(AB)^+ \rightarrow ABCDEFGH$

∴ AB is a candidate key

Q3) R(A, B, C, D, E, F, G, H)

$AB \rightarrow C$

$BD \rightarrow EF$

$AD \rightarrow G$

$A \rightarrow H$

Ans :- $AB \rightarrow C$

$BD \rightarrow EF$ i.e $BD \rightarrow E$, $BD \rightarrow F$

$AD \rightarrow G$

$A \rightarrow H$

$(ABD)^+ = ABDEFGHC$

∴ ABD is a candidate key

Q4) R(A, B, C, D, E)

$BC \rightarrow ADE$

$D \rightarrow B$

Ans :- $BC \rightarrow ADE$ i.e $BC \rightarrow A$, $BC \rightarrow D$, $BC \rightarrow E$

$BC \rightarrow D$, $D \rightarrow B$ } $BC \rightarrow B$

$(AC)^+ = AC$

$(BC)^+ \rightarrow BCADE$ ∴ BC is a candidate key.

$(CD)^+ \rightarrow CDB$ ∴ CD is a candidate key.

Q5) R(A, B, C, D, E)

$AB \rightarrow CD$

$D \rightarrow A$

$BC \rightarrow DE$

Ans:- $AB \rightarrow CD$ i.e $AB \rightarrow C$ & $AB \rightarrow D$

$AB \rightarrow D$, $D \rightarrow A$ } $AB \rightarrow A$

$BC \rightarrow DE$ i.e $BC \rightarrow D$, $BC \rightarrow E$

$BC \rightarrow D$, $D \rightarrow A$ } $BC \rightarrow A$

$(AB)^+ = ADB$, $(BC)^+ = ADEBC$ ∴ BC is a candidate key

$(BD)^+ = BDA$, $(BE)^+ = BE$

$(BA)^+ = ABCDE$ ... Candidate key

$(BC)^+ = ABCDE$ ... Candidate key

$(BD)^+ = BDACE$ ... Candidate key

Super key X:

$(ABC)^+ = ABCDE$ ... Candidate key

$(BCD)^+ = ABCDE$ ... Candidate key

$(ABD)^+ = ABDCE$ ... Candidate key

Q6) R(W, X, Y, Z) $Z \rightarrow W$, $Y \rightarrow XZ$, $WX \rightarrow Y$

Ans:- $Y \rightarrow XZ$ then $Y \rightarrow X$, $Y \rightarrow Z$

$(Y)^+ = YXZW$ ... candidate key

Q) Consider relatn R (A, B, C, D, E, F, G, H) with following FD: CH → G, A → BC, B → CFH, E → A, F → EG. Find out the candidate keys:

Ans:- A → BC

i.e (A → B) & (A → C)

B → CFH

i.e B → C, B → F, B → H

Now, A → B & B → F ∴ (A → F)

Similarly, A → B & B → H ∴ (A → H)

F → EG i.e F → E & F → G

Now, A → F & F → G ∴ (A → G)

Similarly A → F & F → E ∴ (A → E)

A → A B C E F G H

So, (AD)$^+$ → ABCDEFGH ...(By Augmentat?)

∴ (AD)$^+$ is a candidate Key

e.g. (DB)$^+$ → DBCFHEGA &

↓ candidate Key

(DC)$^+$ → D C

↓ Not a candidate Key

(DE)$^+$ → D E A DA already Candidate Key.

↓

∴ Candidate Key

(DF)$^+$ → D F E G DE already candi Key

↓

∴ Candidate Key

(DG)$^+$ → D G Not Key.

Examine the right side attributes of given FD & see which one is not present. Select it & make combinations & then find candidate key

Q8) Consider relatn R(A, B, C, D, E) with FD's. BC → ADE, D → B. Find out candidate key.

Ans:

BC → A, BC → D, BC → E, D → B

$(BC)^+ \rightarrow$ A D E B C

∴ BC is a candidate key.

$(CD)^+ \rightarrow$ C D B A E

∴ CD is a candidate key.

Q9) Consider a table user with foll. colns.
users (Uid, Umail, Fname, LName, city, state, zip). Normalize upto 3NF.

Ans:

1NF:

The users relatn is in 1NF bcoz every attribute contain atomic values.

2NF:

The relatn is said to be in 2NF if every non-prime attribute fully functionally depend on key.

Here Uid is the key that uniquely determines all attributes.

Uid → Umail, Fname, LName, city, state, zip

there is no chance for partial dependency to hold.

Hence, the above relatn is in 2NF.

3NF:

uid → zip & zip → city, state
So, the above table is not in 3NF.

To convert above relatn in 3NF we decompose user table in foll. tables :-

1) Userdetail (uid, umail, Fname, LName, zip);

2) citydetail (city, zip, state);

Q10) Consider the relatn player (playerNO, Name, team, teamcolor, coachNO, coachName, playerposition, teamcaptain); And set of FD as follows :
F={ playerNO → Name, playerNO → playerposition, playerNO → team, coachNO → coachName, team → teamcolor, team → coachNO, team → teamCaptain } 1) Is player relation in 2NF? if not convert it into 2NF. 2) Is Player in 3NF? if not convert it into 3NF.

Soln :- $(playerNO)^+$ → Name, playerposition, team, teamcolor, coachNO, teamcaptain, coachName, playerNO

$(coachNO)^+$ → coachName, coachNO

$(team)^+$ → team, teamcolor, coachNO, teamcaptain, coachName

∴ playerNO is the candidate key.

2NF: The above relatn is in 2NF bcoz there is no chance of partial key dependency.

3NF:

player table hold foll. transitive dependency:

playerNO → team & team → teamcolor, teamcaptain, coachNO

team → coachNO & coachNO → coachName

To convert above relatn in 3NF we decompose player table into foll. tables →

1) playerdetail (playerNO, Name, team, playerposition);

2) teamdetail (team, teamcolor, teamcaptain, coachNO);

3) coachdetail (coachNO, coachName);

Q11) Consider the relatn schema Membership for a library database as follows:

Membership (Mid, name, address, phoneNO, parentMID, ISBN, title, author, borrowdate, returndate, Finedue, Fine paid)

Here parentMID may have the values null, fathername, mothername or both.

Foll. is the set F of F.D that hold in Membership table

Normalize the membership schema upto 3NF

Ans: 1NF: Membership schema is not in 1NF bcoz attribute parentMID is a multivalue attribute, So to solve this we create a separate table as follows:

parentdetail(MID, parentMID);

2NF: For parentdetail table the key is MID, parentMID. Hence, the table is in 3NF.

3NF: After 1NF decompositn we have following schema

parentdetail (MID, parentMID);
Membership (name, address, phoneNO, ISBN, MID, title, author, borrowdate, returndate, Finedue, Fine paid);

2NF: MID, ISBN, borrowdate is the candidate key.

But $(MID)^+ \rightarrow$ Name, address, phoneNO, MID
$(ISBN)^+ \rightarrow$ title, author, ISBN
$(MID, ISBN, borrowdate)^+ \rightarrow$ from MID, ISBN, borrowdate, name, address phoneNo, title, author, returndate, Fine paid, Fine due

Hence, (MID, ISBN, borrowdate) is the candidate key, for Membership schema.

Next, we have to check for partial dependency. The attribute MID, Name, address, phoneNO can be determined by MID alone i.e MID → MID, Name, Address, phoneNO.

only one key → 2NF i.e no chance of partial dependency;

The attributes ISBN, title, author can be determined by using ISBN alone. i.e ISBN → ISBN, title, author

Membership schema shows partial dependency so, it is not in 2NF. we convert membership schema into 2NF as follows:-

1) MID detail (MID, Name, Address, phoneNo);
2) Book detail (ISBN, title, author);
3) Member_detail (MID, ISBN, borrowdate, returndate, Fine_paid, Fine_due);

3NF: As per the given set of FD we don't have any transitive FD in tables. Hence, the list of 3NF tables is as follows:-

1) parentdetail (MID, parentMID);
2) MID detail (MID, Name, Address, phoneNo);
3) Book detail (ISBN, title, author);
4) Memberdetail (MID, ISBN, borrowdate, returndate, Fine paid, Fine due);

(12) Given set of FD to be
E: {B → A, D → A, AB → D}
Find the minimum cover of E.

Ans: AB → D
D → A
AB → A

Step 2) Remove redundant attribute for LHS.
$AB \rightarrow D$ is replaced by $B \rightarrow D$
(as. $B \rightarrow A$ Hence we can eliminate A from $AB \rightarrow D$. Thus we write $B \rightarrow D$)

So, $B \rightarrow A$, $D \rightarrow A$, $B \rightarrow D$.

Step 3) Remove redundant FD.

Now, $\left.\begin{matrix} B \rightarrow D \\ D \rightarrow A \end{matrix}\right\} B \rightarrow A$

From $B \rightarrow D$ & $D \rightarrow A$ we get $B \rightarrow A$ (transitivity)
So $B \rightarrow A$ is redundant FD & it is removed.

~~So, $D \rightarrow A$, $B \rightarrow$~~

Hence minimum cover of E is $\{B \rightarrow D, D \rightarrow A\}$.

~~B Tree~~