Q:- Write the condition of being in 1NF, 2NF, 3NF and BCNF.

Answer **Defintion:-** Data Normalization is the process of re organizing data within a database so that the users can utilize it for further queries & analysis in such a way that <u>data redundancy</u> is minimized.

↳ It is repetition of similar data in same or multiple tables. The objective should be to minimize the data redundancy because ech data takes extra storage. So in other words we can say that the data redundancy causes wastage of storage and may cause data Anomalies.

<u>Examples of Data Normalization :-</u> 1NF, 2NF, 3NF, BCNF etc

1NF - First Normal form:- A table is said to be in 1NF if it follow the below criteria

① **Atomic Values:-** Each column in the table must contain an atomic value. i.e. each cell in the table should store a single piece of data.

② **Unique column Names:-** There should not be duplicate colu i.e there is no ambiguity in referencing column.

③ **Primary Key:-** Each table should have a unique key. This wil be used to identify each row uniquely.

Example

Admission Number	class	Name
101	First	Ram
102	First	Shyam
103	Second	Rahul
104	fourth	Sita
105	Second	Raj

2 NF (Second Normal form):- On top of 1NF, the ② ⑤
second Normal form of database normalization address some
additional form of redundancy. Below are some requirements
that should meet to acheive 2Nf.

1. It must satisfy all rules of 1 NF.
2. Single column primary key that does not functionally
dependent on any subset of candidate key relation.
In simple words, we can say that it has no partial
dependency.

Example:- Suppose we have a table that records info.
about books in a library.

Book_ID Primary Key	Title	Author	Publisher	Shelf
1001	Basic of Maths	K. D. Sharma	Ganga Pub	3
1002	Compound Theory	Y. S. Yadav	Yumcha Pub	3
1003	Newton's Laws	S. R. Bhatia	Harward Pub	1
1004	Computer Networks	Bhola Sharma	Ganga Pub	12
1005	Machine Learning	T. Tripathi	Chand Pub.	2
~~1006~~	~~Basic of Maths~~			

Table 1

foreign Key
Referencing ←

Book_ID	Shelf	Branch	1s-hard cover	Copy No.
1001	3	Maths	Yes	1
1002	3	Maths	Yes	1
1003	1	Physics	No	1
1004	12	Computer Science	No	1
1005	2	Computer Science	Yes	1
1006	5	Maths	Yes	3

Table 2

In table 1, the "Book_ID" is the primary key. This table
has an issue, i.e the attribute "shelf" represent the physical location
of book in the library but it is not fully dependent on primary key
because multiple copies of same book could be in different shelves
So, the "shelf" is dependent on "Book_ID" & also on other infor

Such as library branch or copy number. To solve this lets check table 2 & 3

Table 3

Book_ID	Title	Author	Publisher
1001	Basic of Maths	K.D. Sharma	Ganga Pub.
1002	Compound theory	Y.S. Yadev	Yumuna Pub
1003	Newton's Law	S.R. Bhatia	Harward Pub.
1004	Computer Networks	Bhola Sharma	Garrga Pub.
1005	Machine Learning	T. Tripathi	Chand Pub
~~1006~~	~~Basic of Maths~~		

Now, In Table 3, the "Shelf" attribute is fully functionally dependent on the entire primary key of the "~~book id~~. Table2.

By doing this seperation these tables becomes 2NF.

3rd Normal Form (3NF):-

A table can be said 3NF if it meets the below mentioned conditions

① It must be 2NF.
    1.1. It must be 1NF
    1.2 It must have no partial dependency

② Table does not have any transitive functional dependancy

  2.1 Remove the fields which are independent of the key
  2.2. Move the records to another table if those are relevent to more than one record in the table.

Example:- Below is a record of students of a school

Admission_No	Student_name	Age	Date_of_Birth
1001	Ram	13	22- Nov - 2001
1002	Shyam	12	13 - Aug - 2002
1003	Sita	10	15 - Jan- 2004
1004	Gita	11	17 - July 2003

(4)

exa. here the Student Age & date of birth can be put into different table to eliminate transitive dependency

Table-1:

Addmission_No	Student Name	Date of birth
1001	Ram	22-Nov-2001
1002	Shyam	13-Aug-2002
1003	Sita	15-Jan-2004
1004	Gita	17-July-2003

Table 2

Age	Date-of-birth
13	22-Nov-2001
12	13-Aug-2002
10	15-Jan-2004
11	17-July-2003

BCNF (Boyce-Codd Normal Form):- It is a higher level of Data Normalization whose aim is to remove certain types of anomalies. Below are the condition required for BCNF.

1) Table must satisfy all conditions of 3N.F.

2) for any functional dependency (A→B), A should be either super key or the candidate key. It means A can not be non-primary attribute if B is given as a prime attribute.

example:- Below is a table called "Employee Project"

Employee_ID (Primary Key)	Project_ID (Primary Key)	Employee Name	Project Name	Hours Worked
1001	501	Raj	Diamond	30
1002	502	Ram	Silver	40
1003	501	Rahul	Diamond	50
1004	503	Ramesh	Gold	10
1005	502	Sita	Silver	15
1006	501	Gita	Diamond	50

Here "Employee_ID" & "Project_ID", uniquely identifies each combination of employee & project. But the "employee Name" dependents on "Employee_ID" and the "Project Name" depends on "Project_ID".

To make this table BCNF, we can divide it into 2 tables

Table 1

→ Primary Key

Employee_ID	Employee Name
1001	Raj
1002	Ram
1003	Rahul
1004	Ramesh
1005	Sita
1006	Gita

Primary key
Table 2

Project ID	Project Name
501	Diamond
502	Silver
503	Gold

Foreign Key Referencing

Employee ID	Project ID	Hours
1001	501	30
1002	502	40
1003	501	50
1004	503	10
1005	502	15
1006	501	50

Now, each non-key attribute is fully functionally dependent on candidate key.