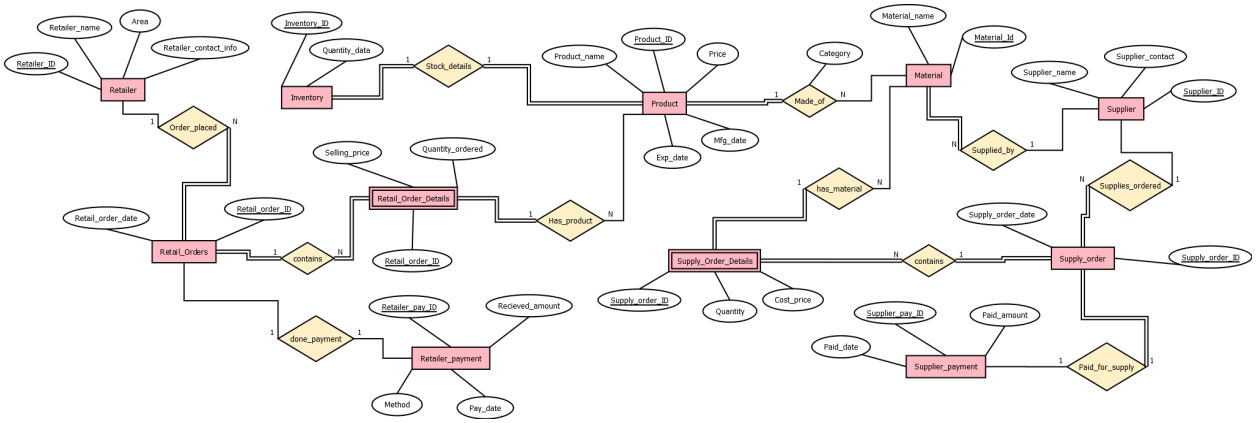
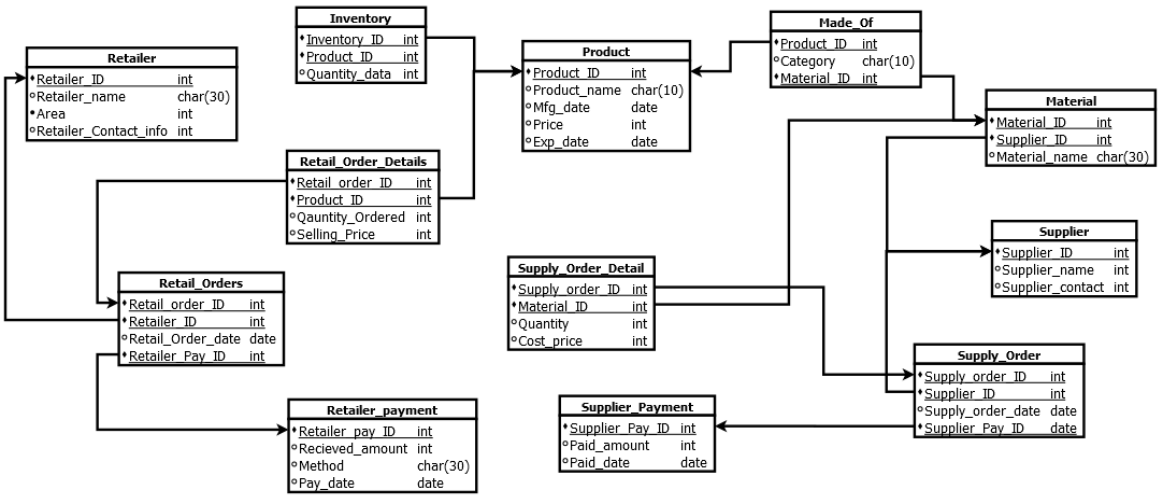
ER DIAGRAM:-



RELATIONAL SCHEMA:-



1. Retailer (Retailer_ID, Retailer_name, Area, Retailer_Contact_info)

1NF:

- **All attributes are atomic (e.g., Retailer_name is a single value).**
- **No repeating groups.**

2NF:

- **Primary Key: Retailer_ID**
- **All non-prime attributes (Retailer_name, Area, Retailer_Contact_info) are fully functionally dependent on the whole primary key, which is atomic.**

3NF:

- **No transitive dependencies. Every non-prime attribute depends only on the key.**

BCNF:

- **All determinants are candidate keys. Here, only Retailer_ID determines everything else.**

4NF:

- **No multivalued dependencies. One retailer has only one name, one area, one contact—no independent multivalued facts.**

2. Inventory (Inventory_ID, Product_ID, Quantity_data)

1NF:

- **Attributes are atomic.**
- **No repeating groups.**

2NF:

- **Primary Key: Inventory_ID**
- **Product_ID and Quantity_data are fully dependent on Inventory_ID.**

3NF:

- **No transitive dependencies.**

BCNF:

- **All functional dependencies have candidate keys as determinants.**

4NF:

- **No independent multivalued dependencies like multiple Product_IDs for same inventory or vice versa.**

3. Product (Product_ID, Product_name, Mfg_date, Exp_date, Price)

1NF:

- **All values are atomic.**

2NF:

- **Primary Key: Product_ID**
- **All other attributes are fully dependent on Product_ID.**

3NF:

- **No transitive dependencies.**
- **For example, Exp_date is not dependent on Mfg_date but directly on Product_ID.**

BCNF:

- **All dependencies are of the form Product_ID → other attributes.**

4NF:

- **There are no independent multivalued facts. Each product has exactly one name, one manufacturing and expiry date, and one price.**

4. Made_Of (Product_ID, Material_ID, Category)

1NF:

- **All fields are atomic, even Category.**

2NF:

- **Composite key: (Product_ID, Material_ID)**
- **Category is fully dependent on the combination of Product_ID and Material_ID.**

3NF:

- **No transitive dependencies (e.g., Category doesn't depend on Product_ID or Material_ID separately).**

BCNF:

- **Both determinants in FDs are candidate keys (composite key).**

4NF:

- **No independent multivalued dependencies: the relation captures one material for one product with one category.**

5. Material (Material_ID, Supplier_ID, Material_name)

1NF:

- **Atomic attributes, no lists or sets.**

2NF:

- **Primary Key: Material_ID**
- **Material_name and Supplier_ID are fully dependent on it.**

3NF:

- **No transitive dependency among attributes.**

BCNF:

- **Only one FD: Material_ID → Supplier_ID, Material_name, and Material_ID is a candidate key.**

4NF:

- **No multivalued dependencies such as multiple suppliers for a single material independently.**

6. Supplier (Supplier_ID, Supplier_name, Supplier_contact)

1NF:

- **Atomic attributes.**

2NF:

- **Primary Key: Supplier_ID**
- **All non-prime attributes depend fully on it.**

3NF:

- **No transitive dependencies.**

BCNF:

- **Functional dependency Supplier_ID → Supplier_name, Supplier_contact satisfies BCNF.**

4NF:

- **No separate sets of values per supplier (e.g., multiple names or contacts).**

7. Retail_Orders (Retail_order_ID, Retailer_ID, Retail_Order_date, Retailer_Pay_ID)

1NF:

- **No repeating groups, all values atomic.**

2NF:

- **Retail_order_ID is the primary key, and all other fields are fully dependent.**

3NF:

- **Retailer_Pay_ID does not determine any other non-key attribute. No transitive dependencies.**

BCNF:

- **All FDs have candidate keys as determinants.**

4NF:

- **Each order has one retailer, one payment, and one date—no multivalued dependencies.**

8. Retail_Order_Details (Retail_order_ID, Product_ID, Quantity_Ordered, Selling_Price)

1NF:

- **Atomic attributes.**

2NF:

- **Composite Key: (Retail_order_ID, Product_ID)**
- **Quantity_Ordered, Selling_Price are dependent on the full key.**

3NF:

- **No transitive dependencies.**

BCNF:

- **Composite candidate key used for all FDs.**

4NF:

- **No independent sets of Product_ID or Retail_order_ID values—each tuple is unique per combo.**

9. Retailer_payment (Retailer_pay_ID, Received_amount, Method, Pay_date)

1NF:

- **All fields are atomic.**

2NF:

- **Retailer_pay_ID is the PK, all others depend fully on it.**

3NF:

- **No field determines another non-key attribute.**

BCNF:

- **One candidate key only; all dependencies valid.**

4NF:

- **No independent sets of Method, Received_amount, or Pay_date.**

10. Supply_Order (Supply_order_ID, Supplier_ID, Supply_order_date, Supplier_Pay_ID)

1NF:

- **Atomic fields, single values only.**

2NF:

- **Primary Key: Supply_order_ID**
- **All attributes depend fully on it.**

3NF:

- **Supplier_Pay_ID doesn't determine other attributes—no transitive dependencies.**

BCNF:

- **All FDs have keys on the LHS.**

4NF:

- **Every supplier order is linked to only one supplier and payment, so no multivalued dependencies.**

11. Supply_Order_Detail (Supply_order_ID, Material_ID, Quantity, Cost_price)

1NF:

- **Atomic data.**

2NF:

- **Composite PK: (Supplier_order_ID, Material_ID)**
- **Quantity, Cost_price depend fully on the full key.**

3NF:

- **No transitive dependencies.**

BCNF:

- **All FDs have composite key on LHS.**

4NF:

- **No multivalued dependencies for same supplier order and material.**

12. Supplier_Payment (Supplier_pay_ID, Paid_amount, Paid_date)

1NF:

- **Atomic attributes.**

2NF:

- **Primary Key: Supplier_pay_ID, others are dependent on it.**

3NF:

- **No attribute determines another.**

BCNF:

- **One candidate key only.**

4NF:

- **One amount and date per payment ID—no multivalued dependencies.**