**AIM:** Normalize the Schema upto 3NF/BCNF to optimize the database, and Write the Questions to be Asked to your solution.

**3NF:**

Address (

    address\_id INT AUTO\_INCREMENT PRIMARY KEY,

    entity\_type ENUM('WORKER', 'CUSTOMER'),

    entity\_id INT,

    street VARCHAR(255),

    city VARCHAR(255),

    postal\_code VARCHAR(20)

);

Worker (

    id INT AUTO\_INCREMENT PRIMARY KEY,

    age INT,

*name* VARCHAR(255),

    aadharNo *FLOAT*,

    gender VARCHAR(1),

    address\_id INT,

    FOREIGN KEY (address\_id) REFERENCES *Address*(address\_id)

);

Machine (

    id INT AUTO\_INCREMENT PRIMARY KEY,

    identifier ENUM('DESIGN', 'PLAIN'),

    capacity *FLOAT*,

    worker\_id INT,

    FOREIGN KEY (worker\_id) REFERENCES Worker(id) ON DELETE *SET* *NULL*

);

Maintenance (

    maintenance\_id INT AUTO\_INCREMENT PRIMARY KEY,

    maintenance\_date TIMESTAMP DEFAULT CURRENT\_TIMESTAMP,

    cost DECIMAL(10,2),

    machine\_id INT,

    FOREIGN KEY (machine\_id) REFERENCES Machine(id)

);

Produced (

    produced\_id INT AUTO\_INCREMENT PRIMARY KEY,

    production\_date DATE,

    quantity INT,

    identifier VARCHAR(255),

    rate DECIMAL(10,2),

    worker\_id INT,

    FOREIGN KEY (worker\_id) REFERENCES Worker(id)

);

Inventory (

    identifier VARCHAR(255) PRIMARY KEY,

    quantity INT,

    rate DECIMAL(10,2)

);

Customer (

    id INT AUTO\_INCREMENT PRIMARY KEY,

    company\_name VARCHAR(255),

    gstin VARCHAR(20),

    address\_id INT,

    shipping\_address\_id INT,

    FOREIGN KEY (address\_id) REFERENCES *Address*(address\_id)

);

Orders (

    bill\_no VARCHAR(10) PRIMARY KEY,

    identifier VARCHAR(255),

    order\_date TIMESTAMP DEFAULT CURRENT\_TIMESTAMP,

    isPaymentDone BOOLEAN,

    customer\_id INT,

    amount DECIMAL(10,2),

    inventory\_type VARCHAR(255),

    FOREIGN KEY (identifier) REFERENCES Inventory(identifier),

    FOREIGN KEY (customer\_id) REFERENCES Customer(id)

);

Material (

    id INT AUTO\_INCREMENT PRIMARY KEY,

    identifier ENUM('COLORED', 'NON\_COLORED'),

    purchase\_date DATE,

    rate DECIMAL(10,2),

    quantity INT

);

**2) 100 QUERIES (QUESTIONS THAT CAN BE ASKED):**

*1) -- Show all workers' details.*

*SELECT* *\** *FROM* Worker;

*2) -- Display all customers' information.*

*SELECT* *\** *FROM* Customer;

*3) -- List all machines with their capacities.*

*SELECT* id, identifier, capacity *FROM* Machine;

*4) -- Show all maintenance records.*

*SELECT* *\** *FROM* Maintenance;

*5) -- Display all produced items with their production dates.*

*SELECT* *\** *FROM* Produced;

*6) -- List all inventory items.*

*SELECT* *\** *FROM* Inventory;

*7) -- Show all orders placed.*

*SELECT* *\** *FROM* Orders;

*8) -- List all material purchases.*

*SELECT* *\** *FROM* Material;

*9) -- Show all workers who are older than 25 years.*

*SELECT* *\** *FROM* Worker *WHERE* age *>* 25;

*10) -- Display all customers whose company name starts with 'A'.*

*SELECT* *\** *FROM* Customer *WHERE* company\_name *LIKE* 'A%';

*11) -- List all machines with a capacity greater than or equal to 150 meters.*

*SELECT* *\** *FROM* Machine *WHERE* capacity *>=* 150;

*12) -- Show all maintenance records with a cost less than 100.*

*SELECT* *\** *FROM* Maintenance *WHERE* cost *<* 100;

*13) -- Display all produced items with a quantity greater than 50.*

*SELECT* *\** *FROM* Produced *WHERE* quantity *>* 50;

*14) -- List all inventory items with a rate greater than 5.*

*SELECT* *\** *FROM* Inventory *WHERE* rate *>* 5;

*15) -- Show all orders where payment is not done.*

*SELECT* *\** *FROM* Orders *WHERE* isPaymentDone *=* FALSE;

*16) -- List all workers who are male and older than 30 years.*

*SELECT* *\** *FROM* Worker *WHERE* gender *=* 'M' *AND* age *>* 30;

*17) -- Display all customers whose company name starts with 'A' or 'B'.*

*SELECT* *\** *FROM* Customer *WHERE* company\_name *LIKE* 'A%' *OR* company\_name *LIKE* 'B%';

*18) -- Show all machines with a capacity greater than 200 or assigned to worker ID 2.*

*SELECT* *\** *FROM* Machine *WHERE* capacity *>* 200 *OR* worker\_id *=* 2;

*19) -- Display all maintenance records with a cost less than 50 or done for machine ID 1.*

*SELECT* *\** *FROM* Maintenance *WHERE* cost *<* 50 *OR* machine\_id *=* 1;

*20) -- List all produced items with a quantity greater than 100 and produced by worker ID 1.*

*SELECT* *\** *FROM* Produced *WHERE* quantity *>* 100 *AND* worker\_id *=* 1;

*21) -- Show all inventory items with a rate greater than 10 and a quantity less than 200.*

*SELECT* *\** *FROM* Inventory *WHERE* rate *>* 10 *AND* quantity *<* 200;

*22) -- Display all orders where payment is not done and the amount is greater than 1000.*

*SELECT* *\** *FROM* Orders *WHERE* isPaymentDone *=* FALSE *AND* amount *>* 1000;

*23) -- List all workers who are older than 25 years or have an Aadhar number.*

*SELECT* *\** *FROM* Worker *WHERE* age *>* 25 *OR* aadharNo *IS NOT NULL*;

*24) -- Show the total number of workers.*

*SELECT* COUNT(*\**) *AS* total\_workers *FROM* Worker;

*25) -- Show the total number of customers.*

*SELECT* COUNT(*\**) *AS* total\_customers *FROM* Customer;

*26) -- Show the total number of machines.*

*SELECT* COUNT(*\**) *AS* total\_machines *FROM* Machine;

*27) -- Show the total number of maintenance records.*

*SELECT* COUNT(*\**) *AS* total\_maintenance *FROM* Maintenance;

*28) -- Show the total number of produced items.*

*SELECT* COUNT(*\**) *AS* total\_produced *FROM* Produced;

*29) -- Show the total number of inventory items.*

*SELECT* COUNT(*\**) *AS* total\_inventory *FROM* Inventory;

*30) -- Show the total number of orders.*

*SELECT* COUNT(*\**) *AS* total\_orders *FROM* Orders;

*31) -- Show the total number of material purchases.*

*SELECT* COUNT(*\**) *AS* total\_material *FROM* Material;

*32) -- Display the average age of workers.*

*SELECT* AVG(age) *AS* average\_age *FROM* Worker;

*33) -- Display the total cost of maintenance.*

*SELECT* SUM(cost) *AS* total\_maintenance\_cost *FROM* Maintenance;

*34) -- Show the total quantity of produced items.*

*SELECT* SUM(quantity) *AS* total\_produced\_quantity *FROM* Produced;

*35) -- Show the total quantity of inventory items.*

*SELECT* SUM(quantity) *AS* total\_inventory\_quantity *FROM* Inventory;

*36) -- Show the total amount of orders.*

*SELECT* SUM(amount) *AS* total\_orders\_amount *FROM* Orders;

*37) -- Show the total quantity of material purchases.*

*SELECT* SUM(quantity) *AS* total\_material\_quantity *FROM* Material;

*38) -- Display the workers along with their addresses.*

*SELECT* Worker.*\**, Address.street, Address.city, Address.postal\_code

*FROM* Worker

*INNER JOIN* *Address* *ON* Worker.address\_id *=* Address.address\_id;

*39) -- Display the customers along with their addresses.*

*SELECT* Customer.*\**, Address.street, Address.city, Address.postal\_code

*FROM* Customer

*INNER JOIN* *Address* *ON* Customer.address\_id *=* Address.address\_id;

*40) -- Show the machines along with the workers assigned to them.*

*SELECT* Machine.*\**, Worker.name *AS* worker\_name

*FROM* Machine

*LEFT JOIN* Worker *ON* Machine.worker\_id *=* Worker.id;

*41) -- Show the orders along with the customer details.*

*SELECT* Orders.*\**, Customer.company\_name, Customer.gstin

*FROM* Orders

*INNER JOIN* Customer *ON* Orders.customer\_id *=* Customer.id;

*42) -- Show the produced items along with the worker details.*

*SELECT* Produced.*\**, Worker.name *AS* worker\_name

*FROM* Produced

*INNER JOIN* Worker *ON* Produced.worker\_id *=* Worker.id;

*43) -- Show the maintenance records along with the machine details.*

*SELECT* Maintenance.*\**, Machine.identifier

*FROM* Maintenance

*INNER JOIN* Machine *ON* Maintenance.machine\_id *=* Machine.id;

*44) -- Show the material purchases along with their types.*

*SELECT* Material.*\**, *CASE* *WHEN* identifier *=* 'COLORED' *THEN* 'Colored' *ELSE* 'Non-Colored' *END* *AS* *type*

*FROM* Material;

*45) -- Display the orders along with the inventory items.*

*SELECT* Orders.*\**, Inventory.*\**

*FROM* Orders

*INNER JOIN* Inventory *ON* Orders.identifier *=* Inventory.identifier;

*46) -- Show the total quantity produced by each worker.*

*SELECT* Worker.id, Worker.name, SUM(Produced.quantity) *AS* total\_quantity\_produced

*FROM* Worker

*LEFT JOIN* Produced *ON* Worker.id *=* Produced.worker\_id

*GROUP BY* Worker.id, Worker.name;

*47) -- Show the total cost of maintenance for each machine type.*

*SELECT* Machine.identifier, SUM(Maintenance.cost) *AS* total\_maintenance\_cost

*FROM* Machine

*LEFT JOIN* Maintenance *ON* Machine.id *=* Maintenance.machine\_id

*GROUP BY* Machine.identifier;

*48) -- Show the total quantity of inventory items for each type.*

*SELECT* identifier, SUM(quantity) *AS* total\_quantity

*FROM* Inventory

*GROUP BY* identifier;

*49) -- Show the total amount of orders for each customer.*

*SELECT* Customer.id, Customer.company\_name, SUM(Orders.amount) *AS* total\_order\_amount

*FROM* Customer

*LEFT JOIN* Orders *ON* Customer.id *=* Orders.customer\_id

*GROUP BY* Customer.id, Customer.company\_name;

*50) -- Show the total quantity produced for each type of identifier.*

*SELECT* identifier, SUM(quantity) *AS* total\_quantity\_produced

*FROM* Produced

*GROUP BY* identifier;

*51) -- Show the average age of workers grouped by gender.*

*SELECT* gender, AVG(age) *AS* average\_age

*FROM* Worker

*GROUP BY* gender;

*52) -- Show the total quantity of material purchases for each type of identifier.*

*SELECT* identifier, SUM(quantity) *AS* total\_quantity

*FROM* Material

*GROUP BY* identifier;

*53) -- Show the average rate of material purchases for each type of identifier.*

*SELECT* identifier, AVG(rate) *AS* average\_rate

*FROM* Material

*GROUP BY* identifier;

*54) -- Show the total number of orders placed by each customer.*

*SELECT* customer\_id, COUNT(*\**) *AS* total\_orders

*FROM* Orders

*GROUP BY* customer\_id;

*55) --Show the Address Details by Entity Type and Entity ID.*

*SELECT* *\** *FROM* *Address* *WHERE* entity\_type *=* ? *AND* entity\_id *=* ?;

*56) --Show the Machines Assigned to Workers Older Than a Specified Age.*

*SELECT* *\** *FROM* Machine *WHERE* worker\_id *IN* (*SELECT* id *FROM* Worker *WHERE* age *>* ?);

*57) --Show the Maintenance Records for Machines with Capacities Greater Than a Given Value.*

*SELECT* *\** *FROM* Maintenance *WHERE* machine\_id *IN* (*SELECT* id *FROM* Machine *WHERE* capacity *>* ?);

*58) --Show the Produced Items by Worker ID and Production Date Range.*

*SELECT* *\** *FROM* Produced *WHERE* worker\_id *=* ? *AND* production\_date *BETWEEN* ? *AND* ?;

*59) --Show the Orders Placed by Customers with Company Names Starting with a Specific Letter.*

*SELECT* *\** *FROM* Orders *WHERE* customer\_id *IN* (*SELECT* id *FROM* Customer *WHERE* company\_name *LIKE* ?);

*60) --Show the Material Purchases by Purchase Date and Quantity Range.*

*SELECT* *\** *FROM* Material *WHERE* purchase\_date *BETWEEN* ? *AND* ? *AND* quantity *BETWEEN* ? *AND* ?;

*61) --Show the Maintenance Records for Machines with Capacities in a Specified Range.*

*SELECT* *\** *FROM* Maintenance *WHERE* machine\_id *IN* (*SELECT* id *FROM* Machine *WHERE* capacity *BETWEEN* ? *AND* ?);

*62) --Show the Produced Items by Production Date and Quantity Range.*

*SELECT* *\** *FROM* Produced *WHERE* production\_date *=* ? *AND* quantity *BETWEEN* ? *AND* ?;

*63) --Show the Orders with Payment Status and Amount Range.*

*SELECT* *\** *FROM* Orders *WHERE* isPaymentDone *=* ? *AND* amount *BETWEEN* ? *AND* ?;

*64) --Show the Material Purchases by Purchase Date and Rate Range.*

*SELECT* *\** *FROM* Material *WHERE* purchase\_date *BETWEEN* ? *AND* ? *AND* rate *BETWEEN* ? *AND* ?;

*65) --Show the Workers by Age and Gender.*

*SELECT* *\** *FROM* Worker *WHERE* age *>* ? *AND* gender *=* ?;

*66) --Show the Customers by City and Postal Code.*

*SELECT* *\** *FROM* Customer *WHERE* address\_id *IN* (*SELECT* address\_id *FROM* *Address* *WHERE* city *=* ? *AND* postal\_code *=* ?);

*67) --Show the Maintenance Records for Machines with Capacities Greater Than a Given Value and Maintenance Cost in a Specified Range.*

*SELECT* *\** *FROM* Maintenance *WHERE* machine\_id *IN* (*SELECT* id *FROM* Machine *WHERE* capacity *>* ?) *AND* cost *BETWEEN* ? *AND* ?;

*68) --Show the Material Purchases by Identifier and Purchase Date Range.*

*SELECT* *\** *FROM* Material *WHERE* identifier *=* ? *AND* purchase\_date *BETWEEN* ? *AND* ?;

*69) --Show the Produced Items by Worker ID and Quantity Range.*

*SELECT* *\** *FROM* Produced *WHERE* worker\_id *=* ? *AND* quantity *BETWEEN* ? *AND* ?;

*70) --Show the Machines with Capacities Greater Than or Equal to a Given Value and Assigned to Workers Younger Than a Specified Age.*

*SELECT* *\** *FROM* Machine *WHERE* capacity *>=* ? *AND* worker\_id *IN* (*SELECT* id *FROM* Worker *WHERE* age *<* ?);

*71) --Show the Maintenance Records for Machines with Capacities Less Than a Given Value and Maintenance Cost in a Specified Range.*

*SELECT* *\** *FROM* Maintenance *WHERE* machine\_id *IN* (*SELECT* id *FROM* Machine *WHERE* capacity *<* ?) *AND* cost *BETWEEN* ? *AND* ?;

*72) --Show the Produced Items by Production Date Range and Quantity.*

*SELECT* *\** *FROM* Produced *WHERE* production\_date *BETWEEN* ? *AND* ? *AND* quantity *=* ?;

*73) --Show the Orders Placed by Customers with a Specific GSTIN.*

*SELECT* *\** *FROM* Orders *WHERE* customer\_id *IN* (*SELECT* id *FROM* Customer *WHERE* gstin *=* ?);

*74) --Show the Material Purchases by Identifier and Quantity Range.*

*SELECT* *\** *FROM* Material *WHERE* identifier *=* ? *AND* quantity *BETWEEN* ? *AND* ?;

*75) --Show the Workers by Age Range and Address City.*

*SELECT* *\** *FROM* Worker *WHERE* age *BETWEEN* ? *AND* ? *AND* address\_id *IN* (*SELECT* address\_id *FROM* *Address* *WHERE* city *=* ?);

*76) --Show the Customers by Company Name and Shipping Address City.*

*SELECT* *\** *FROM* Customer *WHERE* company\_name *=* ? *AND* shipping\_address\_id *IN* (*SELECT* address\_id *FROM* *Address* *WHERE* city *=* ?);

*77) --Show the Orders with Payment Status and Amount Greater Than a Specified Value.*

*SELECT* *\** *FROM* Orders *WHERE* isPaymentDone *=* ? *AND* amount *>* ?;

*78) --Show the Material Purchases by Purchase Date and Identifier.*

*SELECT* *\** *FROM* Material *WHERE* purchase\_date *=* ? *AND* identifier *=* ?;

*79) --Show the Workers by Gender and Postal Code.*

*SELECT* *\** *FROM* Worker *WHERE* gender *=* ? *AND* address\_id *IN* (*SELECT* address\_id *FROM* *Address* *WHERE* postal\_code *=* ?);

*80) --Show the Customers by City and Entity Type.*

*SELECT* *\** *FROM* Customer *WHERE* address\_id *IN* (*SELECT* address\_id *FROM* *Address* *WHERE* city *=* ?) *AND* entity\_type *=* ?;

*81) --Show the Maintenance Records for Machines with Capacities in a Range and Maintenance Date Range.*

*SELECT* *\** *FROM* Maintenance *WHERE* machine\_id *IN* (*SELECT* id *FROM* Machine *WHERE* capacity *BETWEEN* ? *AND* ?) *AND* maintenance\_date *BETWEEN* ? *AND* ?;

*82) --Show the Produced Items by Production Date Range and Worker ID.*

*SELECT* *\** *FROM* Produced *WHERE* production\_date *BETWEEN* ? *AND* ? *AND* worker\_id *=* ?;

*83) --Show the Orders by Customer and Order Date Range.*

*SELECT* *\** *FROM* Orders *WHERE* customer\_id *=* ? *AND* order\_date *BETWEEN* ? *AND* ?;

*84) --Show the Workers by Gender and Entity Type.*

*SELECT* *\** *FROM* Worker *WHERE* gender *=* ? *AND* entity\_type *=* ?;

*85) --Show the Maintenance Records for Machines with Capacities in a Range and Maintenance Cost in a Range.*

*SELECT* *\** *FROM* Maintenance *WHERE* machine\_id *IN* (*SELECT* id *FROM* Machine *WHERE* capacity *BETWEEN* ? *AND* ?) *AND* cost *BETWEEN* ? *AND* ?;

*86) --Show the Produced Items by Production Date and Identifier.*

*SELECT* *\** *FROM* Produced *WHERE* production\_date *=* ? *AND* identifier *=* ?;

*87) --Show the Orders by Amount Range and Inventory Type.*

*SELECT* *\** *FROM* Orders *WHERE* amount *BETWEEN* ? *AND* ? *AND* inventory\_type *=* ?;

*88) --Show the Maintenance Records for Machines with Capacities Less Than or Equal to a Given Value and Maintenance Cost Greater Than a Specified Amount.*

*SELECT* *\** *FROM* Maintenance *WHERE* machine\_id *IN* (*SELECT* id *FROM* Machine *WHERE* capacity *<=* ?) *AND* cost *>* ?;

*89) --Show the Produced Items by Production Date Range and Identifier.*

*SELECT* *\** *FROM* Produced *WHERE* production\_date *BETWEEN* ? *AND* ? *AND* identifier *=* ?;

*90) -- Show the total quantity of inventory items produced by each worker.*

*SELECT* Worker.id, Worker.name, SUM(Produced.quantity) *AS* total\_quantity\_produced

*FROM* Worker

*LEFT JOIN* Produced *ON* Worker.id *=* Produced.worker\_id

*GROUP BY* Worker.id, Worker.name;

*91) -- Show the total amount of orders placed for each type of identifier.*

*SELECT* identifier, SUM(amount) *AS* total\_amount

*FROM* Orders

*GROUP BY* identifier;

*92) -- Show the total quantity of material purchases for each month.*

*SELECT* MONTH(purchase\_date) *AS* *month*, SUM(quantity) *AS* total\_quantity

*FROM* Material

*GROUP BY* MONTH(purchase\_date);

*93) -- Show the total amount of orders placed for each month.*

*SELECT* MONTH(order\_date) *AS* *month*, SUM(amount) *AS* total\_amount

*FROM* Orders

*GROUP BY* MONTH(order\_date);