DATABASE MANAGEMENT SYSTEM - CSA0593

ASSIGNMENT 4

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QUESTION:

Design a database to track product defects across manufacturing processes.

- Create tables for products, defects, production stages, and maintenance records.

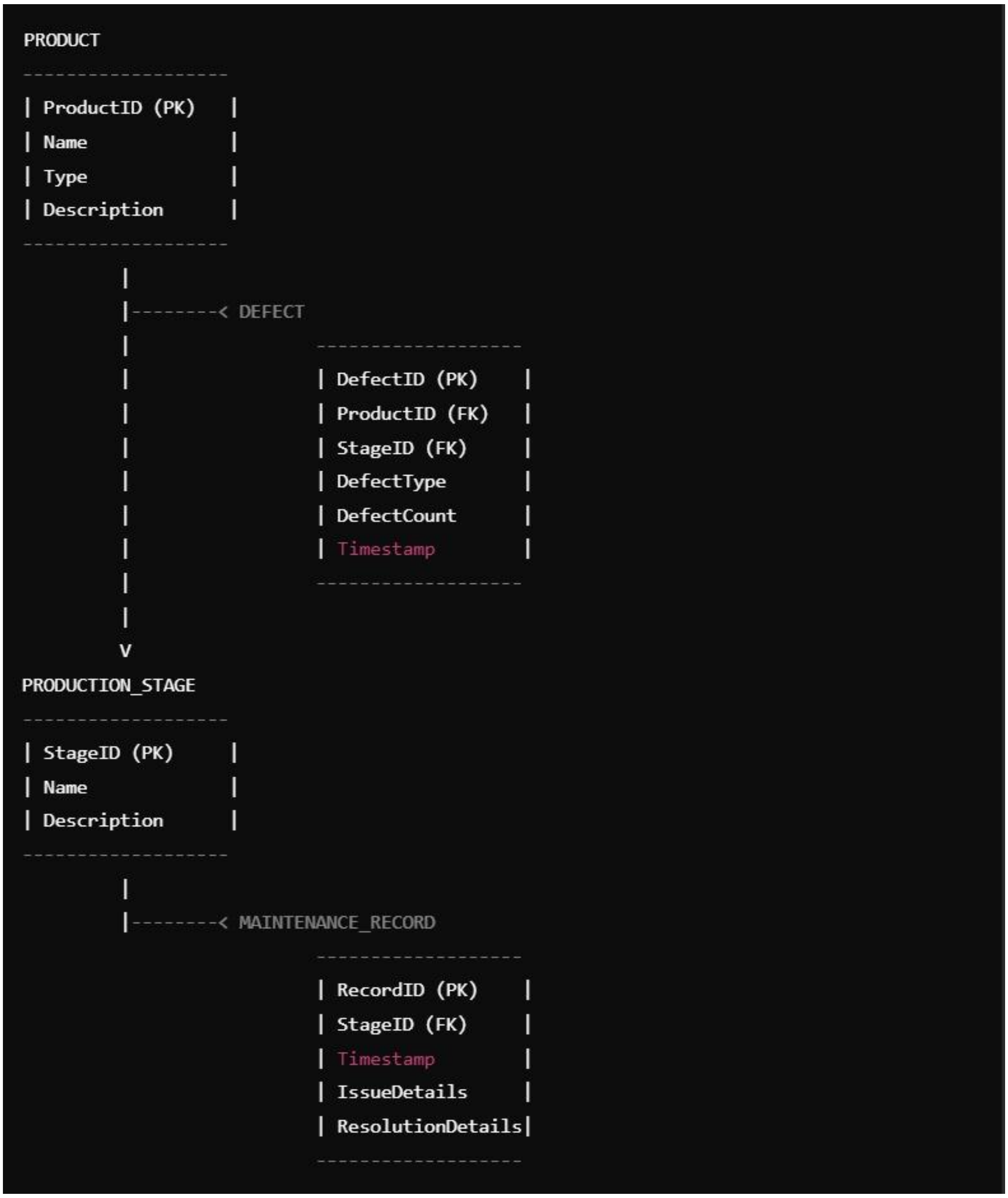
- Write queries to identify defect trends and associate them with specific production stages.

- Implement procedures to update defect counts and notify teams when thresholds are exceeded.

- Discuss optimization strategies for quick access to high-frequency defect data.

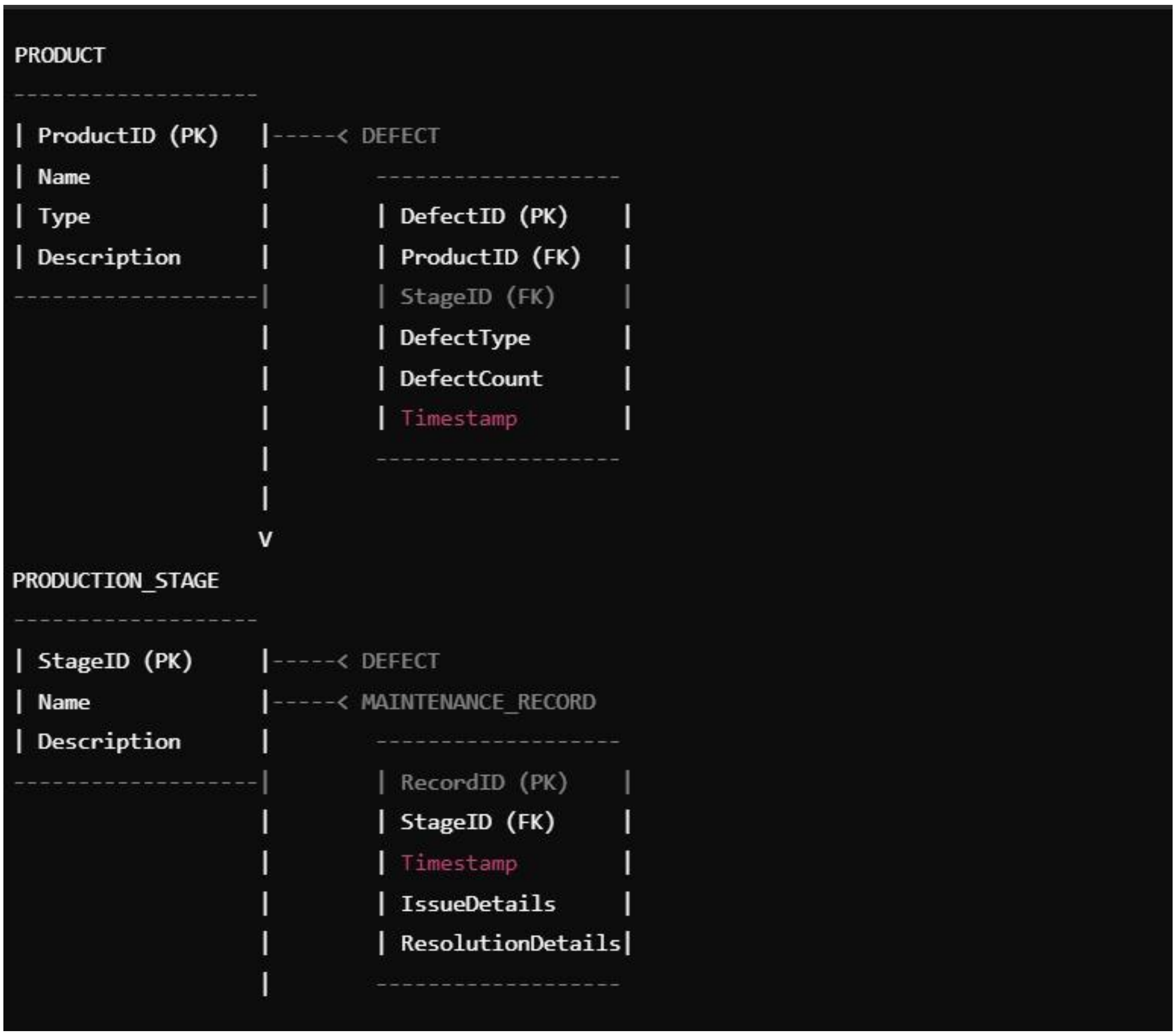
ANSWER:

CONCEPTUAL ER DIAGRAM:



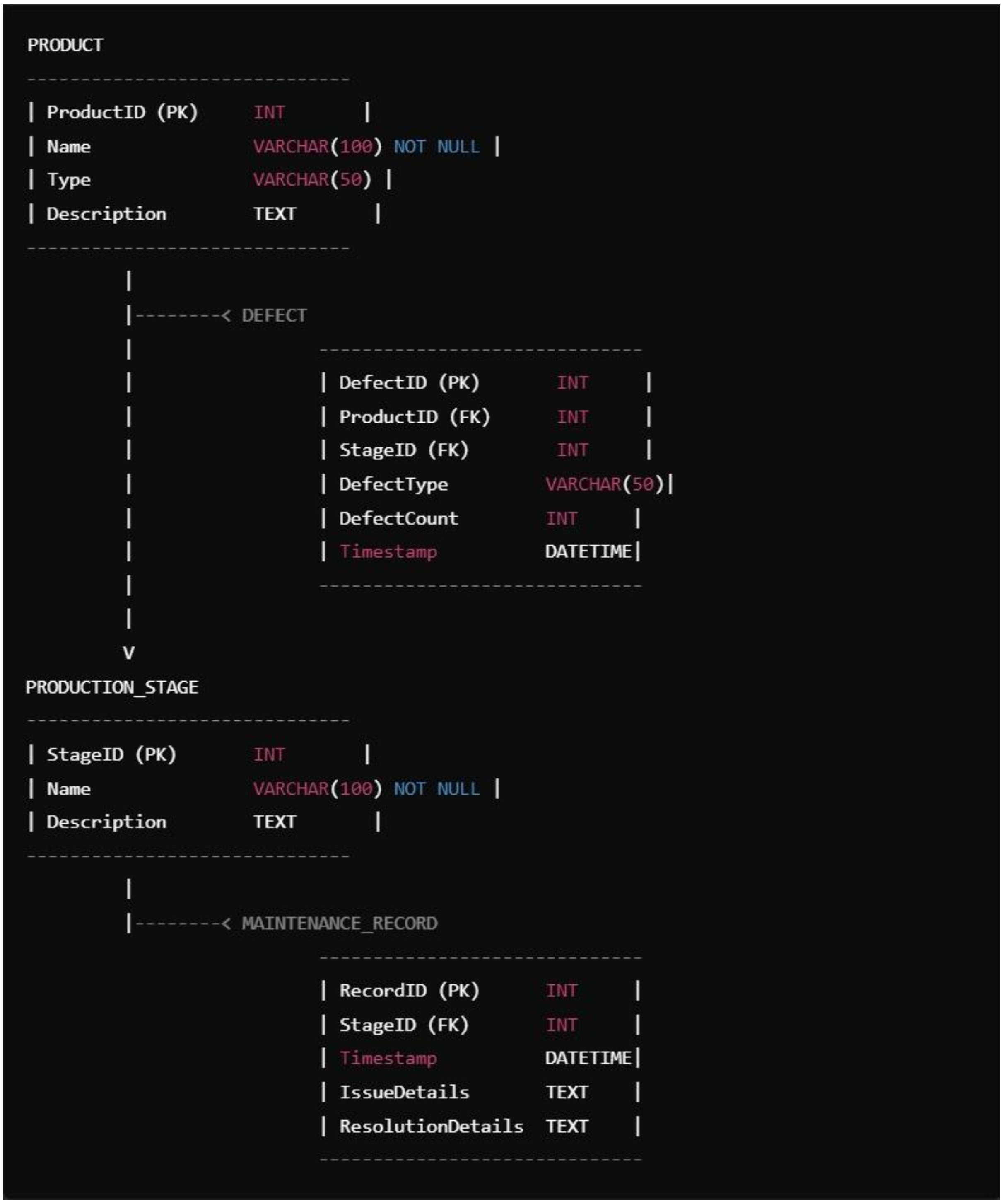
```
PRODUCT
-------------------
| ProductID (PK)   |
| Name             |
| Type             |
| Description      |
-------------------
         |
         |--------< DEFECT
         |                 -------------------
         |                 | DefectID (PK)    |
         |                 | ProductID (FK)   |
         |                 | StageID (FK)     |
         |                 | DefectType       |
         |                 | DefectCount      |
         |                 | Timestamp        |
         |                 -------------------
         |
         |
         v
PRODUCTION_STAGE
-------------------
| StageID (PK)     |
| Name             |
| Description      |
-------------------
         |
         |--------< MAINTENANCE_RECORD
                           -------------------
                           | RecordID (PK)    |
                           | StageID (FK)     |
                           | Timestamp        |
                           | IssueDetails     |
                           | ResolutionDetails|
                           -------------------
```

LOGICAL ER DIAGRAM:



```
PRODUCT
-------------------
| ProductID (PK)    |-----< DEFECT
| Name              |         -------------------
| Type              |         | DefectID (PK)    |
| Description       |         | ProductID (FK)   |
-------------------|         | StageID (FK)     |
                    |         | DefectType       |
                    |         | DefectCount      |
                    |         | Timestamp        |
                    |         -------------------
                    |
                    |
                    v
PRODUCTION_STAGE
-------------------
| StageID (PK)      |-----< DEFECT
| Name              |-----< MAINTENANCE_RECORD
| Description       |         -------------------
-------------------|         | RecordID (PK)    |
                    |         | StageID (FK)     |
                    |         | Timestamp        |
                    |         | IssueDetails     |
                    |         | ResolutionDetails|
                    |         -------------------
```

PHYSICAL ER DIAGRAM:



```
PRODUCT
-----------------------------
| ProductID (PK)     INT       |
| Name               VARCHAR(100) NOT NULL |
| Type               VARCHAR(50) |
| Description        TEXT       |
-----------------------------
         |
         |--------< DEFECT
         |                 -----------------------------
         |                 | DefectID (PK)       INT     |
         |                 | ProductID (FK)      INT     |
         |                 | StageID (FK)        INT     |
         |                 | DefectType         VARCHAR(50)|
         |                 | DefectCount        INT     |
         |                 | Timestamp          DATETIME|
         |                 -----------------------------
         |
         |
         v
PRODUCTION_STAGE
-----------------------------
| StageID (PK)       INT       |
| Name               VARCHAR(100) NOT NULL |
| Description        TEXT       |
-----------------------------
         |
         |--------< MAINTENANCE_RECORD
                           -----------------------------
                           | RecordID (PK)      INT     |
                           | StageID (FK)       INT     |
                           | Timestamp          DATETIME|
                           | IssueDetails       TEXT    |
                           | ResolutionDetails  TEXT    |
                           -----------------------------
```

SQL STATEMENTS:

Database Schema:

```
mysql
CREATE DATABASE DefectTracking;

USE DefectTracking;

CREATE TABLE Products (
  ProductID INT AUTO_INCREMENT PRIMARY KEY,
  ProductName VARCHAR(100),
  ProductDescription VARCHAR(255)
);

CREATE TABLE Defects (
  DefectID INT AUTO_INCREMENT PRIMARY KEY,
  DefectType VARCHAR(100),
  DefectDescription VARCHAR(255)
);

CREATE TABLE ProductionStages (
  StageID INT AUTO_INCREMENT PRIMARY KEY,
  StageName VARCHAR(100),
  StageDescription VARCHAR(255)
);
```

```
CREATE TABLE DefectRecords (
  RecordID INT AUTO_INCREMENT PRIMARY KEY,
  ProductID INT,
  DefectID INT,
  StageID INT,
  RecordDate DATE,
  FOREIGN KEY (ProductID) REFERENCES Products(ProductID),
  FOREIGN KEY (DefectID) REFERENCES Defects(DefectID),
  FOREIGN KEY (StageID) REFERENCES ProductionStages(StageID)
);

CREATE TABLE MaintenanceRecords (
  MaintenanceID INT AUTO_INCREMENT PRIMARY KEY,
  ProductID INT,
  StageID INT,
  MaintenanceDate DATE,
  MaintenanceDescription VARCHAR(255),
  FOREIGN KEY (ProductID) REFERENCES Products(ProductID),
  FOREIGN KEY (StageID) REFERENCES ProductionStages(StageID)
);
```

Queries:

```
mysql
-- Defect Trends
SELECT
  Defects.DefectType,
  COUNT(*) AS DefectCount
```

```
FROM
  Defects
  JOIN DefectRecords ON Defects.DefectID = DefectRecords.DefectID
GROUP BY
  Defects.DefectType;

-- Defect Trends by Production Stage
SELECT
  ProductionStages.StageName,
  Defects.DefectType,
  COUNT(*) AS DefectCount
FROM
  ProductionStages
  JOIN DefectRecords ON ProductionStages.StageID = DefectRecords.StageID
  JOIN Defects ON DefectRecords.DefectID = Defects.DefectID
GROUP BY
  ProductionStages.StageName, Defects.DefectType;
```

Procedures:

```
mysql
DELIMITER //

CREATE PROCEDURE sp_UpdateDefectCount(
  IN defectID INT,
  IN productID INT,
  IN stageID INT
)
```

```
BEGIN

  INSERT INTO DefectRecords (ProductID, DefectID, StageID, RecordDate)
  VALUES (productID, defectID, stageID, CURDATE());

  UPDATE Defects
  SET DefectCount = DefectCount + 1
  WHERE DefectID = defectID;
END //

CREATE PROCEDURE sp_NotifyTeam(
  IN defectID INT,
  IN threshold INT
)

BEGIN
  DECLARE defectCount INT;
  SELECT DefectCount INTO defectCount FROM Defects WHERE DefectID =
defectID;

  IF defectCount > threshold THEN
    -- Send notification to team
    INSERT INTO Notifications (DefectID, NotificationDate)
    VALUES (defectID, CURDATE());
  END IF;
END //

DELIMITER;
```

Optimization Strategies:

1. Create indexes on DefectRecords table for ProductID, DefectID, and StageID columns.
2. Create indexes on Defects table for DefectType column.
3. Use partitioning on DefectRecords table based on RecordDate column.
4. Use caching to store frequently accessed defect data.

mysql

```
CREATE INDEX idx_defect_records_product_id ON DefectRecords (ProductID);
CREATE INDEX idx_defect_records_defect_id ON DefectRecords (DefectID);
CREATE INDEX idx_defect_records_stage_id ON DefectRecords (StageID);

CREATE INDEX idx_defects_defect_type ON Defects (DefectType);

PARTITION BY RANGE (YEAR(RecordDate)) (
  PARTITION p_2022 VALUES LESS THAN (2022),
  PARTITION p_2023 VALUES LESS THAN (2023),
  PARTITION p_2024 VALUES LESS THAN MAXVALUE
);
```

Conclusion:

This database design tracks product defects across manufacturing processes by storing products, defects, production stages, and maintenance records. The queries identify defect trends and associate them with specific production stages. The procedures update defect counts and notify teams when thresholds are exceeded. Optimization strategies ensure quick access to high-frequency defect data.