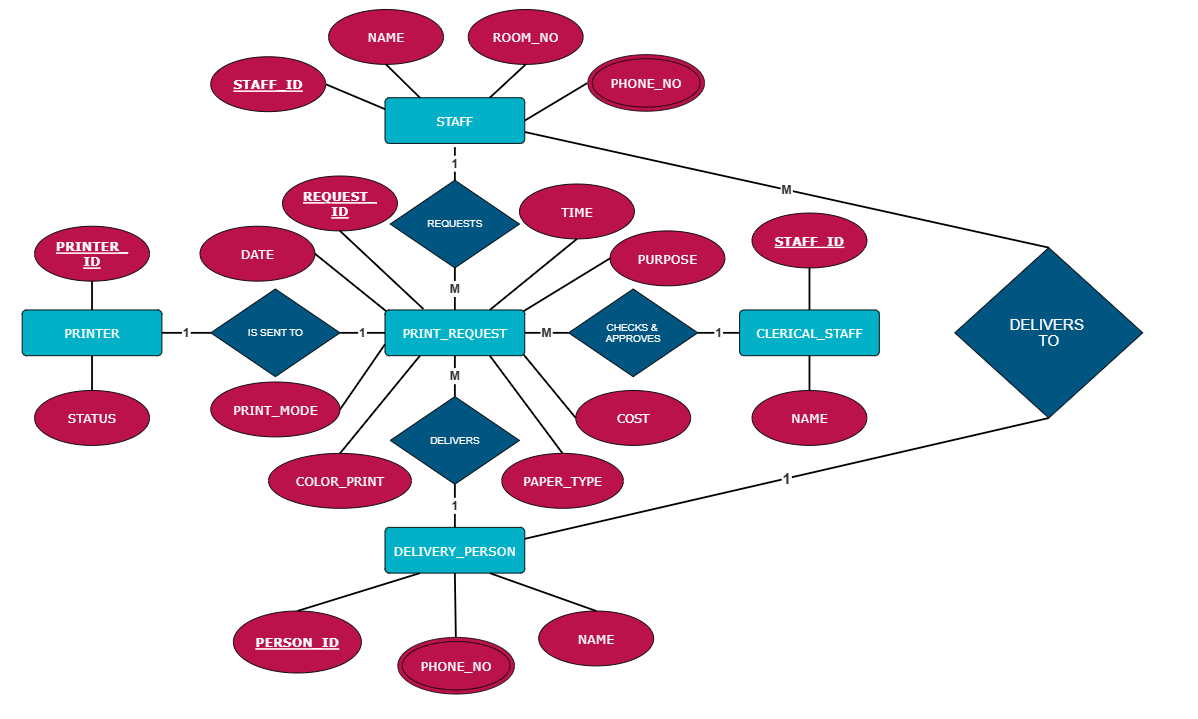
**22AIE303 – PROJECT PHASE 3**

**NORMALIZATION**

**GROUP 5**

|  |  |
| --- | --- |
| **Name** | **Roll number** |
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**ER-DIAGRAM :**



**Original Relation** : staff\_id, staff\_name, staff\_room\_no, staff\_phone (multivalued), printer\_id, printer\_status, clerical\_staff\_id, clerk\_name, delivery\_person\_id, delivery\_person\_phone (multivalued), delivery\_person\_name, print\_request\_id, purpose, time, date, print-mode, color-print, paper-type, cost

**Step 1: 1NF (First Normal Form)**

* In 1NF, a relation must not contain multi-valued attributes. All attributes must have atomic values.
* In the original relation, staff\_phone and delivery\_person\_phone are multi-valued attributes.
* **To transform to 1NF:**
* We need to make staff\_phone and delivery\_person\_phone atomic (i.e., no multiple values for a single attribute in a tuple).
* **Transformation:**
* **staff\_phone**: Each staff member can have multiple phones, so create a new relation for staff\_phone.
* **delivery\_person\_phone**: Similarly, create a new relation for delivery\_person\_phone.
* **The relations in 1NF are:**

1. **Staff**(staff\_id, staff\_name, staff\_room\_no)
   * This stores information about staff members.
2. **Staff\_Phone**(staff\_id, staff\_phone)
   * Since a staff member can have multiple phone numbers, we separate this into a new relation.
3. **Printer**(printer\_id, printer\_status)
   * This stores information about printers.
4. **Clerical\_Staff**(clerical\_staff\_id, clerk\_name)
   * Information about clerical staff.
5. **Delivery\_Person**(delivery\_person\_id, delivery\_person\_name)
   * Information about delivery persons.
6. **Delivery\_Phone**(delivery\_person\_id, delivery\_person\_phone)
   * Since a delivery person can have multiple phone numbers, we create a separate relation for this.
7. **Print\_Request**(print\_request\_id, staff\_id, printer\_id, purpose, time, date, print\_mode, color\_print, paper\_type, cost)
   * Stores information about print requests made by staff, using a printer, with various print settings and associated costs.

* **Final 1NF Relations:**

1. **Staff**(staff\_id, staff\_name, staff\_room\_no)
2. **Staff\_Phone**(staff\_id, staff\_phone)
3. **Printer**(printer\_id, printer\_status)
4. **Clerical\_Staff**(clerical\_staff\_id, clerk\_name)
5. **Delivery\_Person**(delivery\_person\_id, delivery\_person\_name)
6. **Delivery\_Phone**(delivery\_person\_id, delivery\_person\_phone)
7. **Print\_Request**(print\_request\_id, staff\_id, printer\_id, purpose, time, date, print\_mode, color\_print, paper\_type, cost)

**Step 2: 2NF (Second Normal Form)**

2NF Requirements:

* The relation must be in 1NF.
* All non-prime attributes must be fully functionally dependent on the whole primary key. In other words, we need to eliminate partial dependencies, where a non-prime attribute depends only on part of a composite primary key.

**Analysis of Partial Dependencies:**

* **Print\_Request** has a **composite key** (print\_request\_id, staff\_id, printer\_id).
* The **partial dependency** occurs because staff\_name and staff\_room\_no depend only on staff\_id and not on the whole composite key of Print\_Request. Similarly, printer\_status depends only on printer\_id.

**Decomposition for 2NF:**

* Create a new relation for staff attributes (staff\_name, staff\_room\_no) that depend only on staff\_id.
* Create a new relation for printer attributes (printer\_status) that depend only on printer\_id

**New Relations in 2NF:**

1. **Staff**(staff\_id, staff\_name, staff\_room\_no) — *No partial dependency, staff\_name and staff\_room\_no depend fully on staff\_id.*
2. **Staff\_Phone**(staff\_id, staff\_phone) — *No partial dependency, each staff\_id can have multiple staff\_phone numbers.*
3. **Printer**(printer\_id, printer\_status) *— No partial dependency, printer\_status depends fully on printer\_id.*
4. **Clerical\_Staff**(clerical\_staff\_id, clerk\_name) *— This relation remains unchanged as clerk\_name depends fully on clerical\_staff\_id.*
5. **Delivery\_Person**(delivery\_person\_id, delivery\_person\_name) — *No partial dependency as delivery\_person\_name depends fully on delivery\_person\_id.*
6. **Delivery\_Phone**(delivery\_person\_id, delivery\_person\_phone)
7. **Print\_Request**(print\_request\_id, staff\_id, printer\_id, purpose, time, date, print\_mode, color\_print, paper\_type, cost) — *Now this only contains attributes that depend on the whole composite key (print\_request\_id, staff\_id, printer\_id).*

**Step 3: Convert to 3NF (Third Normal Form)**

**3NF Requirements:**

* The relation must be in **2NF**.
* There should be **no transitive dependencies**, i.e., non-prime attributes must not depend on other non-prime attributes.

**Analysis of Transitive Dependencies:**

* In **Print\_Request**, the **attribute cost** might depend on printer\_id (since the cost can vary based on the printer used), and printer\_id is part of the composite key. This creates a **transitive dependency**: cost depends on printer\_id, which is part of the primary key, but cost indirectly depends on the print\_request\_id through printer\_id.

We need to remove this transitive dependency by creating a new relation for printer\_id and cost.

**Decomposition for 3NF:**

* Create a new relation Printer\_Cost that contains printer\_id and cost.

**New Relations in 3NF:**

1. **Staff**(staff\_id, staff\_name, staff\_room\_no) — No transitive dependency.
2. **Staff\_Phone**(staff\_id, staff\_phone) — No transitive dependency.
3. **Printer**(printer\_id, printer\_status) — No transitive dependency.
4. **Clerical\_Staff**(clerical\_staff\_id, clerk\_name) — No transitive dependency.
5. **Delivery\_Person**(delivery\_person\_id, delivery\_person\_name) — No transitive dependency.
6. **Delivery\_Phone**(delivery\_person\_id, delivery\_person\_phone) — No transitive dependency.
7. **Print\_Request**(print\_request\_id, staff\_id, printer\_id, purpose, time, date, print\_mode, color\_print, paper\_type) — No transitive dependency for cost.
8. **Printer\_Cost**(printer\_id, cost) — The cost attribute is now fully dependent on printer\_id.

**Final Relations in 3NF:**

1. **Staff**(staff\_id, staff\_name, staff\_room\_no)
2. **Staff\_Phone**(staff\_id, staff\_phone)
3. **Printer**(printer\_id, printer\_status)
4. **Clerical\_Staff**(clerical\_staff\_id, clerk\_name)
5. **Delivery\_Person**(delivery\_person\_id, delivery\_person\_name)
6. **Delivery\_Phone**(delivery\_person\_id, delivery\_person\_phone)
7. **Print\_Request**(print\_request\_id, staff\_id, printer\_id, purpose, time, date, print\_mode, color\_print, paper\_type)
8. **Printer\_Cost**(printer\_id, cost)