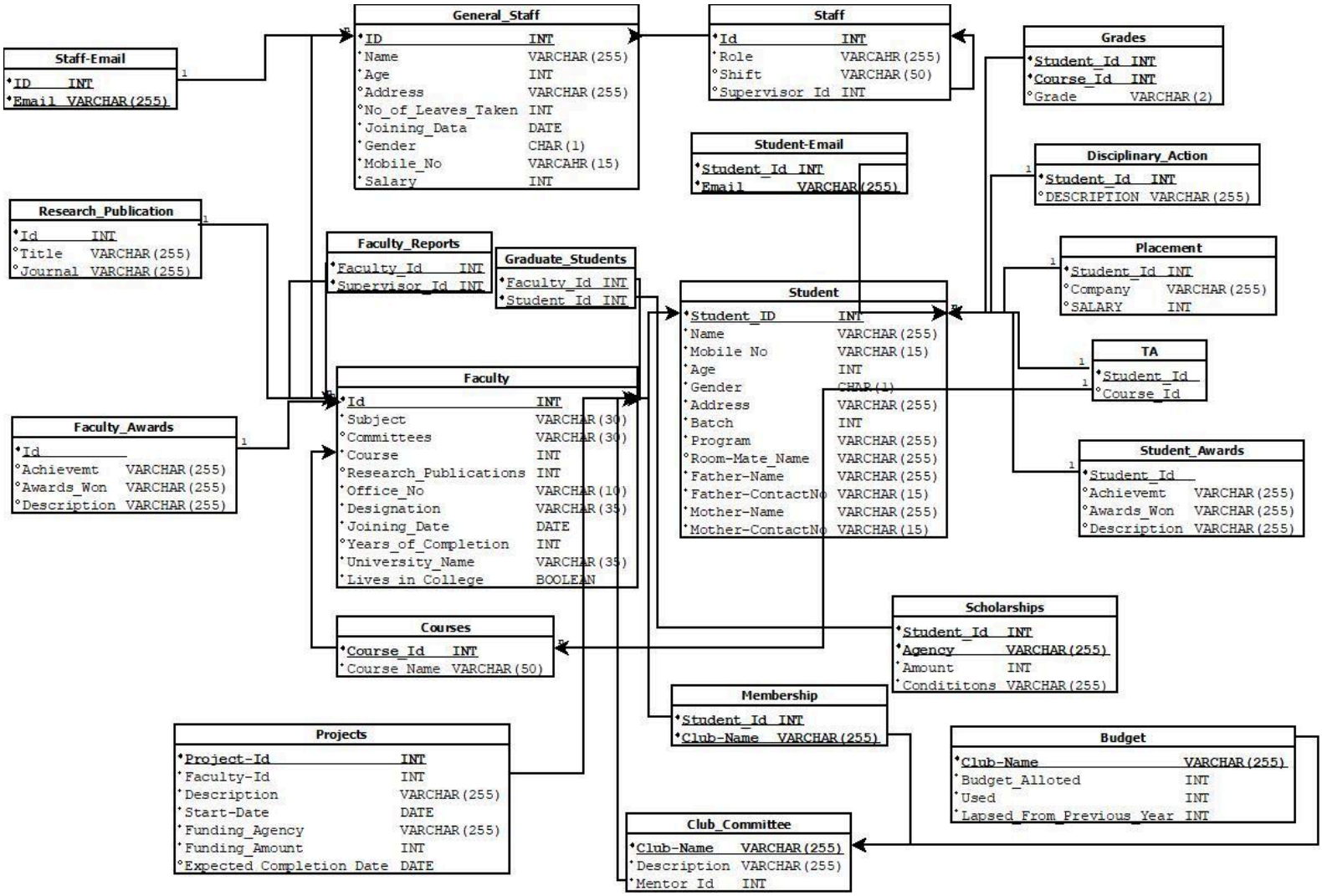
1. Relational Schema:



2. Minimal FD Sets:

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1. **General_Staff:**
   ID → Name
   ID → Age
   ID → Address
   ID → No_of_leaves_Taken
   ID → Joining_Date
   ID → Gender
   ID → Mobile_No
   ID → Salary

2. **Staff:**
   Id → Role
   Id → Shift
   Id → Supervisor_Id

3. **Staff_Email:**
   ID → Email

4. **Student**:
   Student_ID → Name
   Student_ID → Mobile_No
   Student_ID → Age
   Student_ID → Gender
   Student_ID → Address
   Student_ID → Batch
   Student_ID → Program
   Student_ID → Room-Mate_Name
   Student_ID → Father-Name
   Student_ID → Father-ContactNo
   Student_ID → Mother-Name
   Student_ID → Mother_ContactNo

5. **Student_Email**:

Student_Id → Email

6. **Faculty**:
   ID → Subject
   ID → Committees
   ID → Course
   ID → Research_Publications
   ID → Office_No
   ID → Designation
   ID → Joining_Date
   ID → Years_of_Completion
   ID → University_Name
   ID → Lives_in_College

7. **Faculty_Reports**:
   Faculty_Id, Supervisor_Id → [report data]

8. **Graduate_Students**:
   Faculty_Id, Student_Id → [student info]

9. **Faculty_Awards**:
   Id → Achievement
   Id → Awards_Mon
   Id → Description

10. **Research_Publication**:
    Id → Title
    Id → Journal

11. **Courses**:
    Course_Id → Course_Name

12. **Grades**:
    Student_Id, Course_Id → Grade

13. **Disciplinary_Action**:
    Student_Id → Description

14. **Placement**:
    Student_Id → Company
    Student_Id → Salary

15. **TA:**
    Student_Id, Course_Id → [TA Assignment]

16. **Student_Awards**:
    Student_Id, Achievement → Awards_Won
    Student_Id, Achievement → Description

17. **Scholarships:**
    Student_Id, Agency → Amount
    Student_Id, Agency → Conditions

18. **Membership**:
    Student_Id, Club_Name → [membership info]

19. **Club_Committee**:
    Club_Name → Description
    Club_Name → Mentor_Id

20. **Budget**:
    Club_Name → Budget_Alloted
    Club_Name → Used
    Club_Name → Used_From_Previous_Year

21. **Projects**:
    Project_Id → Faculty_Id
    Project_Id → Description
    Project_Id → Start_Date
    Project_Id → End_Date
    Project_Id → Funding_Agency
    Project_Id → Funding_Amount
    Project_Id → Expected_Completion_Date

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3. Proofs for BCNF:

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1. **General Staff (ID, Name, Age, Address, No_of_leaves_Taken, Joining_Date, Gender, Mobile_No, Salary):**

   FDs :
   ID-> {ID, Name, Age, Address, No_of_leaves_Taken, Joining_Date, Gender, Mobile_No, Salary}

   After removing Trivial FDs(ID->ID), we get

   Minimal FD set :
   ID -> {ID, Name, Age, Address, No_of_leaves_Taken, Joining_Date, Gender, Mobile_No, Salary}

   Key:
   $\{ID\}^+$ = (ID, Name, Age, Address, No_of_leaves_Taken, Joining_Date, Gender, Mobile_No, Salary)
   Hence, Key = ID

   NF:
   BCNF : Because the left side of the minimal FD set has key (ID) only.

2. **Staff : (ID, Role, Shift, Supervisor_Id):**

   FDs :
   ID➔{ID, Role, Shift, Supervisor_Id }

After removing Trivial FDs(ID->ID):, we get

Minimal FD set :
ID ➔{Role, Shift, Supervisor_Id}

Key:
{ID}+={ID, Role, Shift, Supervisor_Id}
Hence, Key = ID

NF:
BCNF : Because the left side of the minimal FD set has key (ID) only.

3. **Staff Email : (ID, Email):**

FDs :
{ID, Email}➔{ID, Email}

After removing Trivial FDs(ID->ID, Email->Email), we get

Minimal FD set :
NULL

Key:
Since, after removing trivial FDs the minimal FD
is NULL, this is because key is composite which is
{ID, Email}
Hence, Key = {ID, Email}

NF:
BCNF : Because the minimal set is Empty, This

relation is in BCNF.

4. **Student : (Student_ID, Name, Mobile_No, Age, Gender, Address, Batch, Program, Room-Mate_Name, Father-Name, Father-ContactNo, Mother-Name, Mother_ContactNo)**

   FDs :
   Student_ID➔{Student_ID, Name, Mobile_No, Age, Gender, Address, Batch,Program, Room-Mate_Name, Father-Name, Father-ContactNo,Mother-Name, Mother_ContactNo}

   After removing Trivial FDs(Student_ID->Student_ID), we get

   Minimal FD set :
   Student_ID➔{Name, Mobile_No, Age, Gender, Address, Batch,Program, Room-Mate_Name, Father-Name, Father-ContactNo,Mother-Name, Mother_ContactNo}

   Key:
   {Student_ID}+={Student_ID, Name, Mobile_No, Age, Gender, Address, Batch,Program, Room-Mate_Name, Father-Name, Father-ContactNo,Mother-Name, Mother_ContactNo}

   Hence, Key = Student_ID

   NF:
   BCNF : Because the left side of the minimal FD set has key (Student_ID) only.

5. **Student_Email : (**Student_ID, Email**)**
   FDs :
   Student_ID→{Student_ID, Email}

After removing Trivial FDs (Student_ID->Student_ID), we get

Minimal FD set :
Student_ID➔{Email}

Key:
{Student_ID}+={Student_ID, Email}
Hence, Key = Student_ID

NF:
BCNF : Because the left side of the minimal FD set has key (Student_ID) only.

6. **Faculty : (ID, Subject, Committees, Course, Research_Publications, Office_No, Designation, Joining_Date, Years_of_Completion, University_Name, Lives_in_College) :**

   FDs :
   ID→{ID, Subject, Committees, Course, Research_Publications, Office_No, Designation, Joining_Date, Years_of_Completion, University_Name, Lives_in_College}

   After removing Trivial FDs (ID->ID), we get

   Minimal FD set :
   ID→{Subject, Committees, Course, Research_Publications, Office_No, Designation, Joining_Date, Years_of_Completion, University_Name, Lives_in_College}

   Key:

{ID}+= {ID, Subject, Committees, Course, Research_Publications, Office_No, Designation, Joining_Date, Years_of_Completion, University_Name, Lives_in_College}

Hence, Key = ID

NF:
BCNF : Because the left side of the minimal FD set has key (ID) only.

7. **Faculty_Reports : (Faculty_ID, Supervisor_ID)**

FDs :
Faculty_ID, Supervisor_ID→{Faculty_ID, Supervisor_ID}

After removing Trivial FDs (Faculty_ID->Faculty_ID, Supervisor_ID->Supervisor_ID), we get

Minimal FD set :
NULL

Key:
Since, after removing trivial FDs the minimal FD is NULL, this is because key is composite which is {Faculty_ID, Supervisor_ID}
Hence, Key = {Faculty_ID, Supervisor_ID}

NF:
BCNF : Because the minimal set is Empty, This relation is in BCNF.

8. **Graduate_Students: (Faculty_ID, Student_ID)**

FDs :
{Faculty_Id, Student_Id} = {Faculty_Id, Student_Id}

After removing Trivial FDs (Faculty_ID->Faculty_ID, Student_ID->Student_ID), we get

Minimal FD set :
NULL

Key:
Since, after removing trivial FDs the minimal FD is NULL, this is because key is composite which is {Faculty_ID, Student_ID}
Hence, Key = {Faculty_ID, Student_ID}

NF:
BCNF : Because the minimal set is Empty, This relation is in BCNF.

9. **Faculty_Awards: (Id, Achievement, Awards_Won, Description)**

FDs :
Id → {Id, Achievement, Awards_Mon, Description}

After removing Trivial FDs (Id->Id) we get

Minimal FD set :
Id → {Achievement, Awards_Won, Description}

Key:
{Id}+= {Id, Achievement, Awards_Won, Description}

NF:
BCNF : Because the left side of the minimal FD set has key (Id) only.

10. Research_Publication (Id, Title, Journal)

FDs :
Id→ {Id, Title, Journal}

After removing Trivial FDs (Id->Id), we get

Minimal FD set :
Id ➔ {Title, Journal}

Key:
{Id}+={Title, Journal}
Hence, Key = {Id}

NF:
BCNF :Because the left side of the minimal FD set has key (Id) only.

11. Courses : (CourseID, Course_Name)

FDs :
CourseID→{CourseID, Course_Name}

After removing Trivial FDs (CourseID→CourseID), we get

Minimal FD set :
CourseID→{Course_Name}

Key:
$\{CourseID\}^+$ = {CourseID,Course_Name,Marks}
Hence, Key = CourseID

NF:
BCNF : Because the left side of the minimal FD set has key (CourseID) only.

12. Grades : (Student_Id, Course_Id, Grade)

FDs :
{Student_Id, Course_Id}→{Student_Id, Course_Id, Grade}

After removing Trivial FDs (Student_ID→Student_ID, Course_Id→Course_Id), we get

Minimal FD set :
{Student_Id, Course_Id}→{Grade}

Key:
$\{Student\_Id, Course\_Id\}^+$ = {Student_Id, Course_Id, Grade}
Hence, Key = {Student_Id, Course_Id}

NF:
BCNF : Because the left side of the minimal FD set has key ({Student_Id, Course_Id}) only.

13. Disciplinary_Action : (Student_Id, Description)

FDs :
{Student_Id}→{Student_Id, Description}

After removing Trivial FDs (Student_ID→Student_ID), we get

Minimal FD set :
{Student_Id}→{Description}

Key:
$\{Student\_Id\}^+$ = {Student_Id, Description}
Hence, Key = {Student_Id}

NF:
BCNF : Because the left side of the minimal FD set has key (Student_Id) only.

14. Placement : (Student_Id, Company, SALARY)

FDs :
{Student_Id}→{Student_Id, Company, SALARY}

After removing Trivial FDs (Student_ID→Student_ID), we get

Minimal FD set :
{Student_Id}→{Company, SALARY}

Key:
$\{Student\_Id\}^+$ = {Student_Id, Company, SALARY}
Hence, Key = {Student_Id}

NF:
BCNF : Because the left side of the minimal FD set has key

(Student_Id) only.

15. TA : (Student_Id, Course_Id)

FDs :
{Student_Id, Course_Id} → {Student_Id, Course_Id, [TA assignment]}

After removing Trivial FDs (Student_ID→Student_ID. Course_Id->Course_Id), we get

Minimal FD set :
{Student_Id, Course_Id}→{[TA assignment]}

Key:
$\{Student\_Id, Course\_Id\}^{+}$ = {Student_Id, Course_Id, [TA assignment]}
Hence, Key = {Student_Id, Course_Id}

NF:
BCNF : Because the left side of the minimal FD set has key (Student_Id, Course_Id) only.

16. Student_Awards : (Student_Id, Achievement, Awards_Won, Description)

FDs :
{Student_Id, Achievement} → {Student_Id, Achievement, Awards_Won, Description}

After removing Trivial FDs (Student_ID→Student_ID. Achievement->Achievement), we get

Minimal FD set :
{Student_Id, Achievement}→{Awards_Won, Description}

Key:
{Student_Id, Achievement}$^+$ = {Student_Id, Achievement, Awards_Won, Description}
Hence, Key = {Student_Id, Achievement}

NF:
BCNF : Because the left side of the minimal FD set has key ({Student_Id, Achievement}) only.

17. Scholarships : (Student_Id, Agency, Amount, Conditions)

FDs :
{Student_Id, Agency} → {Student_Id, Agency, Amount, Conditions}

After removing Trivial FDs (Student_ID→Student_ID. Agency->Agency), we get

Minimal FD set :
{Student_Id, Agency}→{Amount, Conditions}

Key:
{Student_Id, Agency}$^+$ = {Student_Id, Agency, Amount, Conditions}
Hence, Key = {Student_Id, Agency}

NF:

BCNF : Because the left side of the minimal FD set has key ({Student_Id, Agency}) only.

18. Membership: (Student_Id, Club_Name, Membership info)

FDs :
{Student_Id, Club_Name} → {Student_Id, Club_Name, Membership info}

After removing Trivial FDs (Student_ID→Student_ID. Club_Name->Club_Name), we get

Minimal FD set :
{Student_Id, Club_Name}→{Membership info}

Key:
$\{Student\_Id, Club\_Name\}^{+}$ = {Student_Id, Club_Name, Membership info}
Hence, Key = {Student_Id, Club_Name}

NF:
BCNF : Because the left side of the minimal FD set has key ({Student_Id, Club_Name}) only.

19. Club_Committee : (Club_Name, Description, Mentor_Id)

FDs :
Club_Name → {Club_Name, Description, Mentor_Id}

After removing Trivial FDs (Club_Name->Club_Name), we get

Minimal FD set :

Club_Name →{Description, Mentor_Id}

Key:
$\{Club\_Name\}^+$ = {Club_Name, Description, Mentor_Id}
Hence, Key = Club_Name

NF:
BCNF : Because the left side of the minimal FD set has key (Club_Name) only.

20. Budget : (Club_Name, Budget_Alloted, Used, Used_From_Previous_Year)

FDs :
Club_Name → {Club_Name, Budget_Alloted, Used, Used_From_Previous_Year}

After removing Trivial FDs (Club_Name->Club_Name), we get

Minimal FD set :
Club_Name →{Budget_Alloted, Used, Used_From_Previous_Year}

Key:
$\{Club\_Name\}^+$ = {Club_Name, Budget_Alloted, Used, Used_From_Previous_Year}
Hence, Key = Club_Name

NF:
BCNF : Because the left side of the minimal FD set has key (Club_Name) only.

21. Projects : (Project_Id, Faculty_Id, Description, Start_Date, End_Date, Funding_Agency, Funding_Amount, Expected_Completion_Date)

FDs :
Project_Id → {Project_Id, Faculty_Id, Description, Start_Date, End_Date, Funding_Agency, Funding_Amount, Expected_Completion_Date}

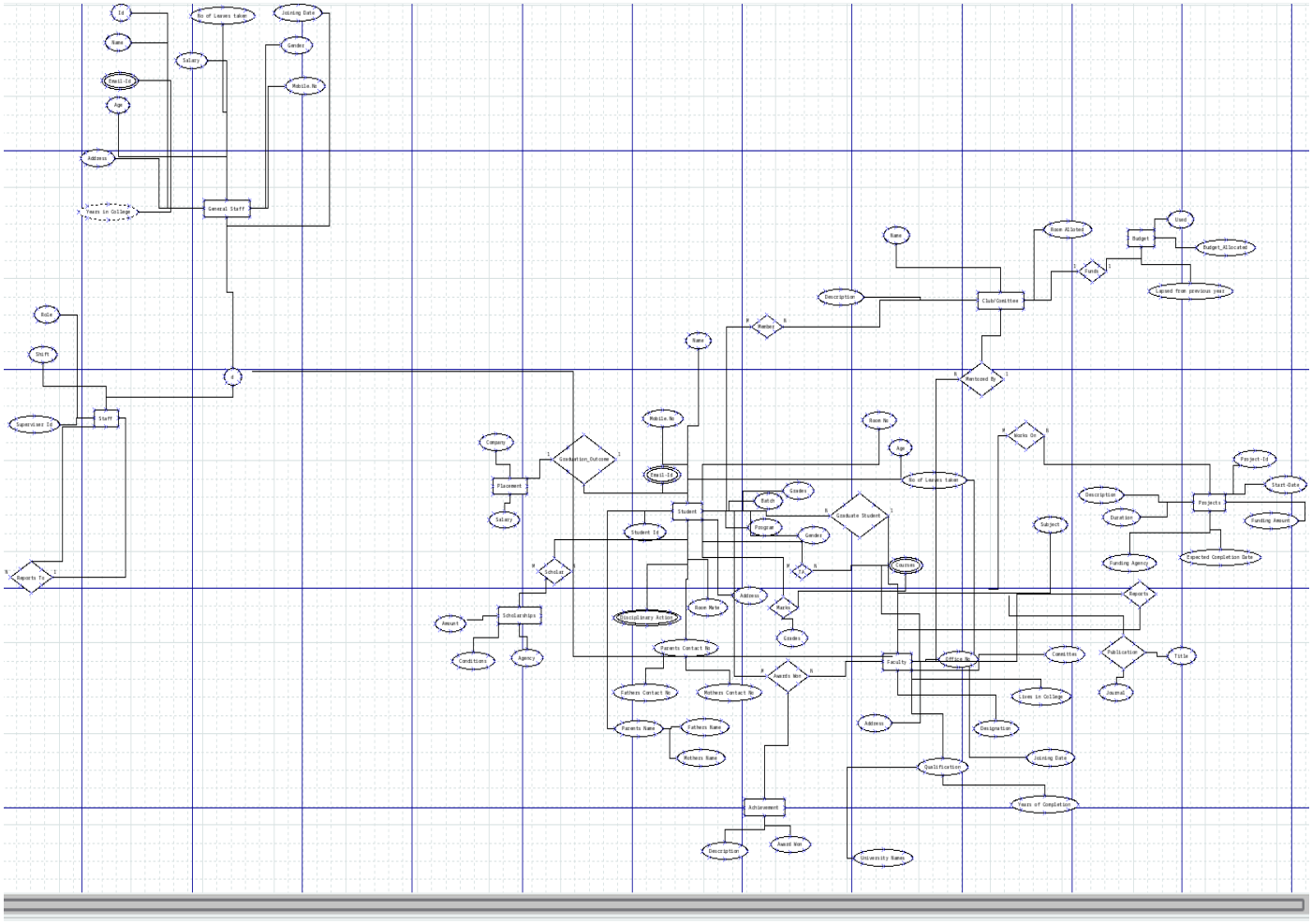
After removing Trivial FDs (Project_Id→ Project_Id), we get

Minimal FD set :
Project_Id→{Faculty_Id, Description, Start_Date, End_Date, Funding_Agency, Funding_Amount, Expected_Completion_Date}

Key:
$\{Project\_Id\}^+$ = {Project_Id, Faculty_Id, Description, Start_Date, End_Date, Funding_Agency, Funding_Amount, Expected_Completion_Date}
Hence, Key = Project_Id
NF:
BCNF : Because the left side of the minimal FD set has key (Project_Id) only.

22. Conclusion: Since all the relations are in their BCNF form. The database has BCNF normal form.

4.ER Diagram


ID
No of Leaves taken
Joining Date
Name
Gender
Salary
Mobile.No
Age
Address
Years in College
General Staff
Role
Shift
Supervisors Id
Staff
Reports To
Name
Room Alloted
Budget
User
Budget_Allocated
Funds
Amount Given previous year
Description
Club/Committee
Member
Name
Mentored By
Company
Evaluation_Outcome
Placement
Salary
Mobile.No
Email-id
Student
Batch
Course
Program
Gender
Student Id
Graduate Student
Scholar
Name
Age
No of Leaves taken
Name Of
Project-Id
Start-Date
Description
Projects
Duration
Funding Amount
Subject
Funding Agency
Expected Completion Date
Courses
Reports To
Address
Marks
Grades
Scholarships
Amount
Conditions
Agency
Room Rate
Disciplinary Actions
Parents Contact No
Fathers Contact No
Mothers Contact No
Parents Name
Fathers Name
Mothers Name
Awards Won
Faculty
Office No
Commitee
Publication
Title
Journal
Lives in College
Address
Designation
Joining Date
Qualifications
Years of Completion
Achievement
Description
Award Won
University Name