1. Projected Functional Dependencies of Patient Relation:
   Patient_ID→Name
   Patient_ID→Gender
   Patient_ID→DOB
   Patient_ID→Street
   Patient_ID→City
   Patient_ID→State
   Patient_ID→Country
   Patient_ID→Contact no.
   Patient_ID→Relative_contact_no
   Patient_ID→Medical history
   City,State →Country

2. Projected Functional Dependencies of Consulted Relation:
   Patient_ID,visit_ID→Consultation_ Date

3. Projected Functional Dependencies of Admitted Relation:
   Patient_ID,visit_ID→Admit_Date
   Patient_ID,visit_ID→Discharge Date
   Patient_ID,visit_ID→Room_No

4. Projected Functional Dependencies of Insurance Relation:
   Policy_No→Company_ID
   Policy_No→Policy_Name
   Policy_No→Company_Name
   Policy_No→cashless_availability
   Policy_No→claim_amt
   Policy_No,Patient_id→Name
   Policy_No,Patient_id→Gender
   Policy_No,Patient_id→DOB
   Policy_No,Patient_id→Street
   Policy_No,Patient_id→City
   Policy_No,Patient_id→State
   Policy_No,Patient_id→Country

5. Projected Functional Dependencies of Employee Relation:
   Emp_ID→Name
   Emp_ID→DOB
   Emp_ID→Gender
   Emp_ID→Street
   Emp_ID→City

Emp_ID→State
Emp_ID→Country
Emp_ID→Salary
Emp_ID→Date_of_join
Emp_ID→Date_of_leaving

6. Projected Functional Dependencies of Doctor Relation:
   Emp_ID→Dep_ID
   Emp_ID→Qualification
   Emp_ID→Consulting_fees
   Emp_ID→Dep_Name
   Emp_ID→Dep_Head_Id

7. Projected Functional Dependencies of Nurse Relation:
   Emp_ID→Shift_time
   Emp_ID→Head_Nurse

8. Projected Functional Dependencies of Receptionist Relation:
   Emp_ID→Shift_time

9. Projected Functional Dependencies of HR_Manager Relation:
   Emp_ID→Shift_time
   Emp_ID→Manager_ID
   Manager_ID→Name
   Manager_ID→DOB
   Manager_ID→Gender
   Manager_ID→Street
   Manager_ID→City
   Manager_ID→Country
   Manager_ID→State
   Manager_ID→Salary
   Manager_ID→Date_of_Join
   Manager_ID→Date_of_leaving

10. Projected Functional Dependencies of Clerk Relation:
    Emp_ID→Shift_time

11. Projected Functional Dependencies of Security guard Relation:
    Emp_ID→Shift_time

12. Projected Functional Dependencies of Janitor Relation:

Emp_ID→Shift_time

13. Projected Functional Dependencies of Department Relation:
    Dep_ID →Dep_Name
    Dep_ID →Dep_Head_ID
    Dep_Head_ID→Qualification
    Dep_Head_ID→Name
    Dep_Head_ID→DOB
    Dep_Head_ID→Gender
    Dep_Head_ID→Street
    Dep_Head_ID→City
    Dep_Head_ID→State
    Dep_Head_ID→Country
    Dep_Head_ID→Consulting_fees
    Dep_Head_ID→Salary
    Dep_Head_ID→Date_of_join
    Dep_Head_ID→Date_of_leaving

14. Projected Functional Dependencies of Medical Equipments Relation:
    E_ID→Name
    E_ID→Cost
    E_ID→Type
    E_ID,Dep_ID→Stock
    E_ID,Dep_ID→Reorder_level

15. Projected Functional Dependencies of Room Relation:
    Room_No→Room_type
    Room_No→Capacity
    Room_No→No_of_beds_available
    Room_No→No_of beds_occupied
    Room_No→charge_per_bed

16. Projected Functional Dependencies of Treatments_available Relation:
    TID→Treatment_name
    TID→Charge
    TID→D_ID
    TID→Dep_Name
    TID→Dep_Head_ID

18. Projected Functional Dependencies of Bill Relation:
    Bill_id→Bill_date
    Bill_id→Patient_id

Bill_id→Policy_No
Bill_id→insurance status
Bill_id→patient_status
Bill_id→claim_amt passed
Bill_id→Total charges
Bill_id→Gender
Bill_id→patient_name
Bill_id→DOB
Bill_id→Street
Bill_id→City
Bill_id→State
Bill_id→Country

Minimal FD sets and BCNF

1) Patient relation

   Patient_ID→Name
   Patient_ID→Gender
   Patient_ID→DOB
   Patient_ID→Street
   Patient_ID→City
   Patient_ID→State
   Patient_ID→Country
   Patient_ID→Contact no.
   Patient_ID→Relative_contact_no
   Patient_ID→Medical history

   Key={Patient_ID}
   The FD minimal set satisfies all BCNF requirements. So the relation is in BCNF.
   R(Patient_ID, Name, Gender, DOB,street, state, city, country,
   contact_no,relative_contact_no, medical history)

   The following three relations are MVDs and hence, violate 4NF.
   Patient_ID→Contact no.
   Patient_ID→Relative_contact_no
   Patient_ID→Medical history

So

R1(Patient_ID,Contact_no)
R2(Patient_ID,Relative_Contact_no)
R3(Patient_ID,Medical,history)
R4(Patient_ID, Name, Gender, DOB,street, state, city, country)

2) Treatments given

Patient_id,visit_id → height
Patient_id,visit_id → weight

key{Patient_id,visit_id}
The FD minimal set satisfies all BCNF requirements. So the relation is in BCNF.

So
R(Patient_id,visit_id,height,weight)

3) Patients_Consulted

Patient_id,visit_id→consultation_date
key{Patient_id,visit_id}
The FD minimal set satisfies all BCNF requirements. So the relation is in BCNF.

So
R(Patient_id,visit_id,consultation_date)

4) Consultation_bill

Visit_id, Case_C_no, Patient_id→cons_charge
Visit_id, Case_C_no, Patient_id→diagnosis
Visit_id, Case_C_no, Patient_id→bill_date

key{Patient_id,visit_id,case_C_no}
The FD minimal set satisfies all BCNF requirements. So the relation is in BCNF.

The following dependency is a MVD

Visit_id, Case_C_no, Patient_id→diagnosis

So
R1(Patient_id,visit_id,case_C_no,diagnosis)
R2(Patient_id, visit_id, case_C_no, cons_charge, bill_date)

5) Patients_admitted

Visit_id, Case_A_no, Patient_id→admit_date
Visit_id, Case_A_no, Patient_id→discharge_date
Visit_id, Case_A_no, Patient_id→room_no

key{Patient_id,visit_id,case_A_no}
The FD minimal set satisfies all BCNF requirements. So the relation is in BCNF.

So
R(Patient_id, visit_id, case_A_no, admit_date, discharge_date, room_no)

6)Intermediate_bill

Case_A_no,patient_id,bill_id→bill_date
Case_A_no,patient_id,bill_id→treatment_id
Case_A_no,patient_id,bill_id→room_no
Case_A_no,patient_id,bill_id→diagnosis
Case_A_no,patient_id,bill_id→special_dr_id
Case_A_no,patient_id,bill_id→opd_dr_id
Case_A_no,patient_id,bill_id→total_charges

key{Patient_id,bill_id,case_A_no}
The FD minimal set satisfies all BCNF requirements. So the relation is in BCNF.

The following dependencies are MVDs
Bill_id, Case_C_no, Patient_id→diagnosis
Bill_id, Case_C_no, Patient_id→treatment_id

So
R1(Patient_id, bill_id_id, case_A_no, bill_date, room_no,special_dr_id, opd_dr_id, total_charges)
R2(Patient_id, bill_id_id, case_A_no,diagnosis)

R3(Patient_id, bill_id_id, case_A_no,treatment_id)

7) Final_bill

Case_A_no,patient_id→policy_no
Case_A_no,patient_id→claim_amt_passed
Case_A_no,patient_id→insurance status

key{Patient_id, case_A_no}
The FD minimal set satisfies all BCNF requirements. So the relation is in BCNF.

So
R(Case_A_no,patient_id,policy_no,claim_amt_passed,insurance_status)

8) Insurance

Policy_no→policy_name
Policy_no→company_id
company_id→company_name
Policy_No→cashless_availability
Policy_No→claim_amt
Policy_no→patient_id

Key{policy_no}
The FD minimal set satisfies all BCNF requirements. So the relation is in BCNF.

The following dependency is a MVD. So it violates 4NF
Policy_no→patient_id

So
R1(policy_no, policy_name, company_id, company_name, cashless_availability, claim_amt)
R2(policy_no,patient_id)

9) Discharge summary

Case_A_no,patient_id→diagnosis
Case_A_no,patient_id→patient_status

key{Patient_id, case_A_no}
The FD minimal set satisfies all BCNF requirements. So the relation is in BCNF.

The following dependency is a MVD

Case_A_no, Patient_id→diagnosis
So
R1(Patient_id, case_A_no, patient_status)
R2(Patient_id, case_A_no,diagnosis)

10) Room

Room_No→Room_type
Room_No→Capacity
Room_No→No_of beds_occupied
Room_No→charge_per_bed

Key{room_no}
The FD minimal set satisfies all BCNF requirements. So the relation is in BCNF.

So
R(room_no,Room_type, Capacity, charge_per_bed, No_of beds_occupied)

11) Departments

Dep_ID →Dep_Name
Dep_ID →Dep_Head_ID

Key{Dep_ID}
The FD minimal set satisfies all BCNF requirements. So the relation is in BCNF.

So
R(Dep_ID, Dep_name, Dep_head_ID)

12) Treatments_available

TID→Treatment_name
TID,date→Charge
TID→D_ID
TID→prerequisite_tests

key{TID,date}
It violates 2NF(partial dependency on keys)

Applying 3NF synthesis algorithm we get
R1(TID, Treatment_name, D_ID, prerequisite_tests)
R2(TID,date,charge)

In R1, prerequisite tests is a MVD, so
R1(TID, Treatment_name, D_ID)
R2(TID,prerequisite_tests)
R3(TID,date,charge)

13) Medical equipments

E_ID→Name
E_ID→Cost
E_ID→Type
E_ID,Dep_ID→Stock
E_ID,Dep_ID→Reorder_level

key{E_ID,Dep_ID}
It violates 2NF(partial dependency on keys)

Applying 3NF synthesis algorithm we get
R1(E_ID, name,cost,type)
R2(E_ID,dep_id,stock,reorder_level)

14) Employee

Emp_ID→Name
Emp_ID→DOB
Emp_ID→Gender
Emp_ID→Street
Emp_ID→City
Emp_ID→State
Emp_ID→Country
Emp_ID→Date_of_join
Emp_ID→Date_of_leaving
Emp_ID→Contact_no
Emp_ID→relative_contact_no

key{Emp_ID}
The FD minimal set satisfies all BCNF requirements. So the relation is in BCNF.

The following relations are MVDs and hence, violate 4NF.
Emp_ID→Contact no.
Emp_ID→Relative_contact_no

So
R1(Emp_ID,Contact_no)
R2(Emp_ID,Relative_Contact_no)
R3(Emp_ID, Name, Gender, DOB,street, state, city, country,Date_of_join,Date_of_leaving)

15) Doctor

Emp_ID→Dep_ID
Emp_ID→Qualification

key{Emp_ID}
The FD minimal set satisfies all BCNF requirements. So the relation is in BCNF.

So
R(emp_id,dep_id,qualification)

16) OPD

Emp_id→consulting_fees
Emp_id→salary
emp_id→%share_of_consulting_fees

key{Emp_ID}
The FD minimal set satisfies all BCNF requirements. So the relation is in BCNF.

So
R(emp_id, consulting_fees, salary, %share_of_consulting_fees)

17) OPD_availability

Emp_id, day→intime
Emp_id, day→outtime

key{Emp_id,day}
The FD minimal set satisfies all BCNF requirements. So the relation is in BCNF.

So
R(Emp_id,day,intime,outtime)

18)OPD_attendance

Emp_ID,date→intime
Emp_ID,date→outtime

key{Emp_id,date}

The FD minimal set satisfies all BCNF requirements. So the relation is in BCNF.

So
R(Emp_id,date,intime,outtime)

19)Resident_Doctor,nurse, security_guard,janitor,receptionist

Emp_id→salary

key{Emp_id}

The FD minimal set satisfies all BCNF requirements. So the relation is in BCNF.

So
R(Emp_id,salary)

20) Attendance_log for Resident_Doctor,nurse, security_guard,janitor,receptionist

Emp_ID,date→intime
Emp_ID,date→out time
Emp_ID,date→shift_type

key{Emp_id,date}

The FD minimal set satisfies all BCNF requirements. So the relation is in BCNF.

So
R(Emp_id,date,intime,outtime,shift_type)

21)Specialised_doctor

emp_id→%share_of_consulting_fees
emp_id→charge _per_visit

key{Emp_ID}

The FD minimal set satisfies all BCNF requirements. So the relation is in BCNF.

So
R(emp_id, %share_of_consulting_fees, charge_per_visit)

22) Special_doctor_visit

Emp_ID,date→intime
Emp_ID,date→out time

key{Emp_id,date}

The FD minimal set satisfies all BCNF requirements. So the relation is in BCNF.

So
R(Emp_id,date,intime,outtime)