**[IV] Point #1:**

**Q) Examine the database relations for BCNF violations. Decompose the relations that are not in BCNF into collections of relations that are in BCNF as necessary.**

F->P

F->D

F->N

A->E

A->D

E->Nb

Ac->C

Nb->N

{F}+={FPDN}

{Nb}+={NbN}

{Ac}+={AcC}

{E}+={ENbN}

{A}+={AENbND}

{P}+={P}

{D}+={D}

{N}+={N}

{C}+={C}

{FNb}+={FNbNPD} FNb->N , FNb->P , FNb->D

{FAc}+={FAcPDNC} FAc->P , FAc->D , FAc->N , FAc->C

{FE}+={FEPDNNb} FE->P , FE->D , FE->N , FE->Nb

{FA}+={FAPDNENb} FA->P , FA->D , FA->N , FA->E , FA->Nb

{FP}+={FPDN} FP->D , FP->N

{FD}+={FDPN} FD->P , FD->N

{FN}+={FNPD} FN->P , FN->D

{FC}+={FCPDN} FC->P , FC->D , FC->N

{NbAc}+={NbNAcC} NbAc->C , NbAc->N

{NbE}+={NbEN} NbE->N

{NbA}+={NbAEDN} NbA->E , NbA->D , NbA->N

{NbP}+={NbPN} NbP->N

{NbD}+={NbDN} NbD->N

{NbN}+={NbN}

{NbC}+={NbCN} NbC->N

{AcE}+={AcECNNb} AcE->C , AcE->N , AcE->Nb

{AcA}+={AcACEDNNb} AcA->C , AcA->E , AcA->D , AcA->N , AcA->Nb

{AcP}+={AcPC} AcP->C

{AcD}+={AcDC} AcD->C

{AcN}+={AcNC} AcN->C

{AcC}+={AcC}

{EA}+={EANNbD} EA->N , EA->Nb , EA->D

{EP}+={EPNbN} EP->Nb , EP->N

{ED}+={EDNbN} ED->Nb , ED->N

{EC}+={ECNbN} EC->Nb , EC->N

{AP}+={APENNbD} AP->E , AP->N , AP->Nb , AP->D

{AD}+={ADENNb} AD->E , AD->N , AD->Nb

{AN}+={ANNbED} AN->Nb , AN->E , AN->D

{PD}+={PD}

{PN}+={PN}

{PC}+={PC}

{DN}+={DN}

{DC}+={DC}

{NC}+={NC}

{EN}+={ENNb} EN->Nb

{FNbAc}+={FNbAcPDNC} FNbAc->P , FNbAc->D , FNbAc->N , FNbAc->C

{FNbE}+={FNbEPDN} FNbE->P , FNbE->D , FNbE->N

{FNbA}+={FNbAPDNE} FNbA->P , FNbA->D , FNbA->N , FNbA->E

{FNbP}+={FNbPDN} FNbP->D , FNbP->N

{FNbD}+={FNbPDN} FNbD->P , FNbD->N

{FNbN}+={FNbPDN} FNbN->P , FNbN->D

{FNbC}+={FNbCPDN} FNbC->P , FNbC->D , FNbC->N

{FAcE}+={FAcEPDCNbN} FAcE->P , FAcE->D , FAcE->C , FAcE->Nb , FAcE->N

{FAcA}+={FAcAPDNCENb} FAcA->P , FAcA->D , FAcA->N , FAcA->C , FAcA->E , FAcA->Nb

{FAcP}+={FAcPDNC} FAcP->D , FAcP->N , FAcP->C

{FAcD}+={FAcDPNC} FAcD->P , FAcD->N , FAcD->C

{FAcN}+={FAcNPDC} FAcN->P , FAcN->D , FAcN->C

{FAcC}+={FAcCPDN} FAcC->P , FAcC->D , FAcC->N

{FEA}+={FEAPDNNb} FEA->P , FEA->D , FEA->N , FEA->Nb

{FEP}+={FEPDNNb} FEP->D , FEP->N , FEP->Nb

{FED}+={FEDPNNb} FED->P , FED->N , FED->Nb

{FEN}+={FEDPNNb} FEN->P , FEN->D , FED->Nb

{FEC}+={FECPDNNb} FEC->P , FEC->D , FEC->Nb , FEC->N

{FAP}+={FAPDNENb} FAP->D , FAP->N , FAP->E , FAP->Nb

{FAD}+={FAPDNENb} FAD->P , FAD->N , FAD->E , FAD->Nb

{FAN}+={FANPDENb} FAN->D , FAN->P , FAN->E , FAN->Nb

{FAC}+={FACPDNENb} FAC->D , FAC->N , FAC->E , FAC->Nb , FAC->P

{FPD}+={FPDN} FPD->N

{FPN}+={FPDN} FPN->D

{FPC}+={FPCDN} FPC->D , FPC->N

{FDN}+={FPDN} FDN->P

{FDC}+={FDCPN} FDC->P , FDC->N

{FNC}+={FNCPD} FNC->P , FNC->D

{NbAcE}+={NbAcENC} NbAcE->N , NbAcE->C

{NbAcA}+={NbAcANCED} NbAcA-> , NbAcA->N , NbAcA->C , NbAcA->E , NbAcA->D

{NbAcP}+={NbAcPNC} NbAcP->N , NbAcP->C

{NbAcD}+={NbAcDNC} NbAcD->N , NbAcD->C

{NbAcN}+={NbAcNC} NbAcN->C

{NbAcC}+={NbAcCN} NbAcC->N

{NbEA}+={NbEAND} NbEA->N , NbEA->D

{NbEP}+={NbEPN} NbEP->N

{NbED}+={NbEDN} NbED->N

{NbEN}+={NbEN}

{NbEC}+={NbECN} NbEC->N

{NbAP}+={NbAPNED} NbAP->N , NbAP->E , NbAP->D

{NbAD}+={NbADNE} NbAD->N , NbAD->E

{NbAN}+={NbANED} NbAN->E , NbAN->D

{NbAC}+={NbACEDN} NbAC->E , NbAC->D , NbAC->N

{NbPD}+={NbPDN} NbPD->N

{NbPN}+={NbPN}

{NbPC}+={NbPCN} NbPC->N

{NbDN}+={NbDN}

{NbDC}+={NbDCN} NbDC->N

{NbNC}+={NbNC}

{AcEA}+={AcEACNNbD} AcEA->C, AcEA->N , AcEA->Nb , AcEA->D

{AcEP}+={AcEPCNNb} AcEP->C , AcEP->N , AcEP->Nb

{AcED}+={AcEDCNNb} AcED->C , AcED->N , AcED->Nb

{AcEN}+={AcENCNb} AcEN->C , AcEN->Nb

{AcEC}+={AcECNNb} AcEC->N , AcEC->Nb

{AcAP}+={AcAPCEDNNb} AcAP->C , AcAP->E , AcAP->D , AcAP->N , AcAP->Nb

{AcAD}+={AcADCENNb} AcAD->C , AcAD->E , AcAD->N , AcAD->Nb

{AcAN}+={AcANCEDNb} AcAN->C , AcAN->E , AcAN->D , AcAN->Nb

{AcAC}+={AcACEDNNb} AcAC->E , AcAC->D , AcAC->N , AcAC->Nb

{AcPD}+={AcPDC} AcPD->C

{AcPN}+={AcPNC} AcPN->C

{AcPC}+={AcPC}

{AcDN}+={AcDNC} AcDN->C

{AcDC}+={AcDC}

{AcNC}+={AcNC}

{EAP}+={EAPNNbD} EAP->N , EAP->Nb , EAP->D

{EAD}+={EADNNb} EAD->N , EAD->Nb

{EAN}+={EANNbD} EAN->Nb , EAN->D

{EAC}+={EACNNbD} EAC->N , EAC->Nb , EAC->D

{EPD}+={EPDNNb} EPD->N , EPD->Nb

{EPN}+={EPNNb} EPN->Nb

{EPC}+={EPCNNb} EPC->N , EPC->Nb

{EDN}+={EDNNb} EDN->Nb

{EDC}+={EDCNNb} EDC->N , EDC->Nb

{ENC}+={ENCNb} ENC->Nb

{APD}+={APDENNb} APD->E , APD->N , APD->Nb

{APN}+={APNDENb} APN->D , APN->E , APN>Nb

{APC}+={APCEDNNb} APC->E , APC->D , APC->N , APC->Nb

{ADN}+={ADNENb} ADN->E , ADN->Nb

{ADC}+={ADCNENb} ADC->N , ADC->E , ADC->Nb

{ANC}+={ANCEDNb} ANC->E , ANC->D , ANC->Nb

{PDN}+={PDN}

{PDC}+={PDC}

{PNC}+={PNC}

{DNC}+={DNC}

{FNbAcE}+={FNbAcEPDNC} FNbAcE->P , FNbAcE->D , FNbAcE->N , FNbAcE->C

{FNbAcA}+={FNbAcAEPDNC} FNbAcA->E , FNbAcA->P , FNbAcAE->D , FNbAcA->N,

FNbAcA->C

{FNbAcP}+={FNbAcPDNC} FNbAcP->D , FNbAcP->N , FNbAcP->C

{FNbAcD}+={FNbAcPDNC} FNbAcD->P , FNbAcD->N , FNbAcD->C

{FNbAcN}+={FNbAcPDNC} FNbAcN->P , FNbAcN->D , FNbAcD->C

{FNbAcC}+={FNbAcCPDN} FNbAcC->P , FNbAcC->N , FNbAcC->D

{FNbEA}+={FNbEAPDN} FNbEA->P , FNbEA->D , FNbEA->N

{FNbEP}+={FNbEPDN} FNbEP->D , FNbEP->N

{FNbED}+={FNbEDPN} FNbED->P , FNbED->N

{FNbEN}+={FNbENPD} FNbEN->P , FNbEN->D

{FNbEC}+={FNbECPDN} FNbEC->P FNbEC->D FNbEC->N

{FNbAP}+={FNbAPDNE} FNbAP->D , FNbAP->N , FNbAP->E

{FNbAD}+={FNbADPNE} FNbAD->P , FNbAD->N , FNbAD->E

{FNbAN}+={FNbANPDE} FNbAN->P , FNbAN->D , FNbAN->E

{FNbAC}+={FNbACPDNE} FNbAC->P FNbAC->D , FNbAC->N , FNbAC->E

{FNbPD}+={FNbPDN} FNbPD->N

{FNbPN}+={FNbPDN} FNbPD->N

{FNbPC}+={FNbPCDN} FNbPC->D , FNbPC->N

{FNbDN}+={FNbDNP} FNbDN->P

{FNbDC}+={FNbDCPN} FNbDC->P , FNbDC->N

{FNbNC}+={FNbNCPD} FNbNC->P , FNbNC->D

{NbAcEA}+={NbAcEANCD} NbAcEA->N , NbAcEA->C , NbAcEA->D

{NbAcEP}+={NbAcEPNC} NbAcEP->N , NbAcEP->C

{NbAcED}+={NbAcEDNC} NbAcED->N , NbAcED->C

{NbAcEN}+={NbAcENC} NbAcEN->C

{NbAcEC}+={NbAcENC} NbAcEC->N

{NbAcEA}+={ NbAcEANCD} NbAcEA->N , NbAcEA->C , NbAcEA->D

{NbAcEP}+={NbAcEPNC} NbAcEP->N , NbAcEP->C

{NbAcED}+={NbAcEDNC} NbAcED->N , NbAcED->C

{NbAcEN}+={NbAcENC} NbAcEN->C

{NbAcEC}+={NbAcECN} NbAcEC->N

{NbAcAP}+={NbAcAPNCED} NbAcAP->N , NbAcAP->C , NbAcAP->E , NbAcAP->D

{NbAcAD}+={NbAcADNCE} NbAcAD->N , NbAcAD->C , NbAcAD->E

{NbAcAN}+={NbAcANCED} NbAcAN->C , NbAcAN->E , NbAcAN->D

{NbAcAC}+={NbAcACNED} NbAcAC->N , NbAcAC->E , NbAcAC->D

{NbAcDN}+={NbAcDNC} NbAcDN->C

{NbAcDC}+={NbAcDCN} NbAcDC->N

{NbAcNC}+={NbAcNC}

{AcEAP}+={AcEAPCNNbD} AcEAP->C , AcEAP->N , AcEAP->Nb , AcEAP->D

{AcEAD}+={AcEADCNNb} AcEAD->C , AcEAD->N , AcEAD->Nb

{AcEAN}+={AcEANCNbD} AcEAN->C , AcEAN->Nb , AcEAN->D

{AcEAC}+={AcEACNNbD} AcEAC->N , AcEAC->Nb , AcEAC->D

{AcEPD}+={AcEPDCNNb} AcEPD->C , AcEPD->N , AcEPD->Nb

{AcEPN}+={AcEPNCNb} AcEPN->C , AcEPN->Nb

{AcEPC}+={AcEPCNNb} AcEPC->N , AcEPC->Nb

{AcEDN}+={AcEDNCNb} AcEDN->C , AcEDN->Nb

{AcEDC}+={AcEDCNNb} AcEDC->N , AcEDC->Nb

{AcENC}+={AcENCNb} AcENC->Nb

{EAPD}+={EAPDNNb} EAPD->N , EAPD->Nb

{EAPN}+={EAPNDNb} EAPN->D , EAPN->Nb

{EAPC}+={EAPCNNbD} EAPC->N , EAPC->Nb , EAPC->D

{EADN}+={EADNNb} EADN->Nb

{EADC}+={EADCNNb} EADC->N , EADC->Nb

{EANC}+={EANCNbD} EANC->Nb , EANC->D

{APDN}+={APDNENb} APDN->E , APDN->Nb

{APDC}+={APDCENNb} APDC->E , APDC->N , APDC->Nb

{APNC}+={APNCEDNb} APNC->E , APNC->D , APNC->Nb

{PDNC}+={PDNC}

The key is **FAcA** as it functionally determines all attributes.

The super key is **FAcANb.**

In relation R to decompose relations into BCNF,We list attributes in relation R and identify functional dependencies not in BCNF

R(C,F,N,Nb,P,D,A,Ac,E)

F->P is not in BCNF

Now compute closure of F as {F}+={F,P,D,N} then

R1(F,P,D,N)  R2(C,F,Nb,A,Ac,E)

S1={F->P

F->D

F->N}

KEY:=F

R2(C,F,Nb,A,Ac,E)

A->E is not in BCNF

Now compute closure of A as {A}+={A,E,Nb}

R21(A,E,Nb)  R22(C,F,A,Ac)

S2:={A->E

A->Nb}

KEY:=A

R22(C,F,A,Ac)

Ac->C is not in BCNF

Now compute closure of Ac as {Ac}+={Ac,C}

R221(Ac,C)  R221(F,A,Ac)

S3:={Ac->C}

KEY:=Ac KEY:=F,A,Ac

Hence ,all relations are in BCNF