NORMALIZATION of DMBS for **"CoursePlanner"**

Student

StudentId	FirstName	LastName	doubleMajor?

Functional Dependencies:
StudentId -> FirstName, LastName, doubleMajor?

There is no multi-valued attribute, composite attribute or their combinations. => it is in   1NF

There is no partial dependency. ie. All non-key attributes are fully functional dependent on the primary key. => it is in   2NF

It is already in 2NF and it also does not contain any transitive partial dependency. => it is in   3NF

It is already in 3NF and for every functional dependency the determinants are candidate keys. => it is in   BCNF

BCNF
Student(StudentId, FirstName, LastName, doubleMajor)

StudentDepartmentInfo

RegistrationNo	RegistrationStartDate	DepartmentId -	StudentId -

Functional Dependencies:
RegistrationNo -> RegistrationStartDate, DepartmentId, StudentId
DepartmentId, StudentId -> RegistrationNo, RegistrationStartDate

There is no multi-valued attribute, composite attribute or their combinations. => it is in   1NF

There is no partial dependency. ie. All non-key attributes are fully functional dependent on the primary key. => it is in   2NF

There is a violation of 3NF since there is the following transitive dependency:

DepartmentId,StudentId -> RegistrationNo
RegistrationNo -> RegistrationStartDate
DepartmentId,StudentId -> RegistrationStartDate

StudentDepartmentRegistrationNoInfo

FK	FK	
DepartmentId	StudentId	RegistrationNo

Functional Dependencies:
DepartmentId, StudentId -> RegistrationNo

StudentDepartmentRegistrationDateInfo

RegistrationNo	RegistrationStartDate

RegistrationNo -> RegistrationStartDate

Now the violation of 3NF is fixed so it is now in   3NF

It is already in 3NF and for every functional dependency the determinants are candidate keys. => it is in   BCNF

BCNF
StudentDepartmentRegistrationNoInfo(DepartmentId, StudentId, RegistrationNo)
StudentDepartmentRegistrationDateInfo(RegistrationNo, RegistrationStartDate)

Department

DepartmentId	DepartmentName

Functional Dependencies:
DepartmentId -> DepartmentName

There is no multi-valued attribute, composite attribute or their combinations. => it is in   1NF

There is no partial dependency. ie. All non-key attributes are fully functional dependent on the primary key. => it is in   2NF

It is already in 2NF and it also does not contain any transitive partial dependency. => it is in   3NF

It is already in 3NF and for every functional dependency the determinants are candidate keys. => it is in   BCNF

BCNF
Department(DepartmentId, DepartmentName)

Session

SessionId	CourseId	SessionCapacity	SessionWaitlistFlag	SessionStartTime	SessionFinishTime	SessionDuration	SessionDay	SessionLocation	SessionSemester	SessionType

Functional Dependencies:
SessionStartTime,SessionFinishTime,SessionDay,SessionLocation,SessionSemester -> SessionId, SessionCapacity, sessionWaitlistFlag, SessionDuration, SessionType
SessionStartTime,SessionFinishTime -> SessionDuration
SessionId -> CourseId, SessionCapacity,SessionWaitlistFlag, SessionStartTime, SessionFinishTime, SessionDuration, SessionDay, SessionLocation,SessionSemester, SessionType

There is no multi-valued attribute, composite attribute or their combinations. => it is in   1NF
There is a partial dependency in the following functional dependencies:

SessionStartTime,SessionFinishTime,SessionDay,SessionLocation,SessionSemester -> sessionDuration
SessionStartTime,SessionFinishTime -> sessionDuration

SessionTime

SessionStartTime	SessionFinishTime	SessionDuration

Session

SessionId	CourseId	SessionCapacity	SessionWaitlistFlag	SessionStartTime	SessionFinishTime	SessionDay	SessionLocation	SessionSemester	SessionType

It is now in 2NF and it also does not contain any transitive partial dependency. => it is in   3NF
It is already in 3NF and for every functional dependency the determinants are candidate keys. => it is in   BCNF

BCNF
SessionTime(SessionStartTime, SessionFinishTime, SessionDuration)
Session(SessionId, CourseId,SessionCapacity,SessionWaitlistFlag, SessionStartTime, SessionFinishTime,SessionDay, SessionLocation, SessionSemester,SessionType)

Course

CourseId	DepartmentId -	CourseCatalogNumber	CourseSubject	PSDSFlag	LabFlag

Functional Dependencies:
CourseId -> DepartmentId,CourseCatalogNumber,CourseSubject, PSDSFlag, LabFlag
CourseSubject, CourseCatalogNumber -> CourseId, DepartmentId, PSDSFlag, LabFlag

There is no multi-valued attribute, composite attribute or their combinations. => it is in   1NF

There is no partial dependency. ie. All non-key attributes are fully functional dependent on the primary key. => it is in   2NF

There is a violation of 3NF since there is the following transitive dependency:

CourseCatalogNumber, CourseSubject -> CourseId
CourseId -> DepartmentId
CourseCatalogNumber, CourseSubject -> DepartmentId

CourseCatalogNumber, CourseSubject -> CourseId
CourseId -> PSDSFlag, LabFlag
CourseCatalogNumber, CourseSubject -> PSDSFlag, LabFlag

CourseInfo

CourseId	FK		
CourseId	DepartmentId	PSDSFlag	LabFlag

Functional Dependencies:
CourseId -> DepartmentId, PSDSFlag, LabFlag

CourseCode

CourseId	CourseCatalogNumber	CourseSubject

CourseId -> CourseSubject, CourseCatalogNumber

Now the violation of 3NF is fixed so it is now in   3NF

It is already in 3NF and for every functional dependency the determinants are candidate keys. => it is in   BCNF

BCNF
CourseInfo(CourseId, DepartmentId, PSDSFlag, LabFlag)
CourseInfo(CourseId, CourseCatalogNumber, CourseSubject)

CourseTaken

CourseTakenId	isPassed?	CourseTakenSemester	StudentId -	CourseId -

Functional Dependencies:
CourseTakenId -> isPassed?, CourseTakenSemester, StudentId, CourseId
StudentId, CourseId -> CourseTakenId, isPassed?, CourseTakenSemester

There is no multi-valued attribute, composite attribute or their combinations. => it is in   1NF

There is no partial dependency. ie. All non-key attributes are fully functional dependent on the primary key. => it is in   2NF

There is a violation of 3NF since there is the following transitive dependency:

StudentId, CourseId -> CourseTakenId
CourseTakenId -> isPassed?
StudentId, CourseId -> isPassed?

StudentId, CourseId -> CourseTakenId
CourseTakenId -> CourseTakenSemester
StudentId, CourseId -> CourseTakenSemester

CourseTaken_Info

CourseTakenId	isPassed?	CourseTakenSemester

Functional Dependencies:
CourseTakenId -> isPassed?, CourseTakenSemester

CourseTaken_StudentCourseInfo

CourseTakenId	FK	FK
CourseTakenId	StudentId	CourseId

CourseTakenId -> StudentId, CourseId

Now the violation of 3NF is fixed so it is now in   BCNF

It is already in 3NF and for every functional dependency the determinants are candidate keys. => it is in   BCNF

BCNF
CourseTaken_Info(CourseTakenId, isPassed?, courseTakenSemester)
CourseTaken_StudentCourseInfo(CourseTakenId, StudentId, CourseId)

Normalized Final Version (e.g. all in BCNF)

Student

StudentId	FirstName	LastName	doubleMajor?

StudentDepartmentRegistrationNoInfo

FK	FK	
DepartmentId	StudentId	RegistrationNo

StudentDepartmentRegistrationDateInfo

RegistrationNo	RegistrationStartDate

Department

DepartmentId	DepartmentName

SessionTime

SessionStartTime	SessionFinishTime	SessionDuration

Session

SessionId	CourseId	SessionCapacity	SessionWaitlistFlag	SessionStartTime	SessionFinishTime	SessionDay	SessionLocation	SessionSemester	SessionType

CourseInfo

CourseId	FK		
CourseId	DepartmentId	PSDSFlag	LabFlag

CourseCode

CourseId	CourseCatalogNumber	CourseSubject

CourseTaken_Info

CourseTakenId	isPassed?	CourseTakenSemester

CourseTaken_StudentCourseInfo

CourseTakenId	FK	FK
CourseTakenId	StudentId	CourseId