Task 1. Will the conversion to BCNF be dependency preserving in any case? Proof your statement and give a reasoning for choosing BCNF design.

Proof:

We only need to give a counter example: Consider the following schema.

a b c and c->b

Clearly the above schema is in 3NF because ab->c is a superkey dependency and, from c->b we can see that b-c=b, which is a subset of the primary key (such dependency) is also allowed in 3NF).

But the above schema is not in BCNF because c->b is neither super-key nor trivial dependency. So, we decompose above schema, keeping it lossless.

Only possible lossless decomposition is ac and cb. (Because their intersection c is primary key for the 2nd table).

But clearly the dependency ab-> c is lost.

Hence, proved.

Task 2. Given table in 1NF, convert to 3NF if PK is UnitID:

UnitID	Date	Tutor ID	Topic	Room
U1	23.02.03	Tut1	GMT	629
U2	18.11.02	Tut3	Gln	631
U4	04.07.03	Tut5	AVQ	621
U5	05.05.03	Tut3	PhF	632

StudentID	UnitID	Grade
St1	U1	4.7
St1	U2	5.1
St2	U4	5.0
St2	U5	4.9
St4	U1	4.3

Topic	Book
GMT	Deumlich
Gln	Zehnder
PhF	Dümmlers
AVQ	SwissTopo

Tutor ID	TutEmail
Tut1	tut1@fhbb.ch
Tut3	tut3@fhbb.ch
Tut5	tut5@fhbb.ch

Task 3. Given table in 1NF, convert to 2NF if PK is {ProjectName, ProjectManager}, use decomposition:

ProjectName	ProjectManager	Budget	TeamSize
Project1	Manager1	1 kk $	15
Project2	Manager2	1.5 kk $	12

ProjectManager	Position
Manager1	CTO
Manager2	CTO2

Task 4. Given table, convert to 3NF if PK is Group, use decomposition:

Faculties have a number of specialities, each speciality consists of a set of particular groups.

Group	Faculty	Speciality
g1	f1	s1
g2	f2	s2

Faculty	Speciality
f1	s1
f2	s2

Group	Speciality
g1	s1
g2	s2

Task 5. Given table, convert to BCNF if PK is {ProjectID, Department}, use decomposition:

Curator depends on projectID and related departments, teamSize directly relates to project and related departments, ProjectGroupsNumber depends on TeamSize.

ProjectID	Curator	TeamSize
p1	e1	100
p2	e2	120

ProjectID	Department
p1	d1
p2	d2

TeamSize	ProjectGroups Number
100	5
120	6

Task 6. List the three design goals for relational databases and explain why each is desirable. Give an example of both desirable and undesirable types of decompositions.

Our goals of database design with functional dependencies are:
1. BCNF – eliminates all redundancy that can be discovered based on functional dependencies.
2. Losslessness – guarantees that the join of relations will result in the same relation as it was decomposed.
3. Dependency preservation – saves dependency after decomposition.

They are desirable so we can maintain an accurate database, check correctness of updates quickly, and use the smallest amount of space possible.

Types of decomposition:
1. Lossy – may lose some info from initial table
2. Lossless join – there is no loss of info when we replace one relation by two relations