

**Question 2** *(5 points)*

Consider the relation R(V, W, X, Y, Z) with FDs {Z → Y, Y → Z,X → Y,X → V, VW → X}.

**a.** Show the closure for attribute X given the functional dependencies above.

**b.** List the possible keys for relation R based on the functional dependencies above.

**Question 3** *(5 points)*

Consider the relation R(A,B,C,D,E) with FDs {BC → ADE, D → B}. The possible keys are {B,C} and {C,D}.

**a.** Identify the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). Justify your answer.

**b.** If the relation is not in BCNF, decompose it until it becomes BCNF.

**Question 4** *(5 points)*

Consider the relation R(A,B,C,D,E,F) with FDs {AB → C,DC → AE,E → F}. The possible keys are {A,B,D} and {B,C,D}.

**a.** Identify the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). Justify your answer.

**b.** Is the decomposition R1(A,B,C,D) R2(B,C,D,E,F) a dependency preserving decomposition? Justify your answer.

**Question 5** *(5 points)*

Given the relation R(W, X, Y, Z) and set of functional dependencies (FDs) F = {X → W, WZ → XY, Y → WXZ}. Compute the minimal cover for F.

**Question 6** *(12 points)*

Use the two relations given below to write the following queries in SQL:

EMP( SSN, FirstName, LastName, Title, Salary, DeptId, MgrId)

DEPT( Did, DepartmentName, TotalBudget)

Foreign Keys: DeptId references DEPT.Did and MgrId references EMP.SSN

**a.** Find the name, total budget of departments in which the total salary of all people working in that department exceeds the total budget of the department.

**b.** Find the first and last name of employees whose salary is greater than the salary of their manager.

**c.** Find name of departments that does not have any employees with title ”Vice President” working in them.

**Question 7** *(8 points)*

Consider the following patient database:

|  |  |  |
| --- | --- | --- |
| CLAIM | | |
| CaseId | Amount | Type |
| 1 | 10000 | InPatient |
| 3 | 30000 | Emergency |

|  |  |
| --- | --- |
| PATIENT | |
| PatNo | Pname |
| 123 | Isbah |
| 234 | Izaan |
| 345 | Tahreem |
| 456 | Alia |

|  |  |  |
| --- | --- | --- |
| MEDICALCASE | | |
| CaseId | PatNo | InjuryDate |
| 1 | 123 | 2011-05-15 |
| 2 | 234 | 2011-05-20 |
| 3 | 123 | 2011-10-15 |
| 4 | 123 | 2012-01-15 |
| 5 | 123 | 2012-05-15 |

Write the output of the following queries:

**a.** R←  Pname, InjuryDate, CaseId, Type ((Patient PatNo= PatNo MedicalCase)  CaseId=CaseId Claim)

**b.** S(PatNo,Pname,Count) ← PatNo, Pname ℱ COUNT CaseId ((Patient PatNo=PatNo MedicalCase) CaseId=CaseId Claim)

**Question 8** *(10 points)*

Draw an ER diagram to represent the information below as closely as possible. Show all attributes, keys, participation constraints, cardinality ratios and when necessary relationship role explicitly. If you choose not to represent some of the information in the ER model below, explain why.

This database models parts sold by different suppliers, located in different countries.

* Parts have an indetifier PartNo, name, brand, type, and retailprice.
* Suppliers have name (unique), address, phone number.
* Nations are identified by a nation code, and name.
* Geographic regions are indentified by a name and additional description.
* Nations typically belongs to specific geographic regions.
* Suppliers are affiliated with a specific nation, and supply different parts. Each part can be supplied by multiple suppliers.
* Parts can be subparts of another part, and each part can be composed of multiple subparts.
* Suppliers of different nations belongs to specific unions, a union has a name, and a foundation data. Each union may have multiple suppliers, but all suppliers of a union have to be from the same geographic region.

**Question 9** *(5 points)*

Map the ER diagram given below, to relational schema. Clearly specify all the primary keys (PKs) and foreign keys (FKs).

