Assignment: Database Management Systems

1. A relation R' has these attributes MNOPQRST containing only atomic values. The set of functional dependencies (FDs) for R' are given as F+ = {OT->S, M -> NO, N -> ORT, Q -> M, R -> QS} . F+ is exactly the set of FDs that hold for R'. How many candidate keys does the relation R' have?

2. Consider the FDs given in above question. The relation R' is in which normal form ?

3. Statement: Every relation in BCNF is also in 3NF. Comment if the statement is true or false. Explain with help of an example.

4. Let us consider a table having single record for each registered student. The attributes of the table are as follows:
    1. *Reg_Number*: A unique 10 digit registration number of each student
    2. *Aadhaar*: A 11 digit number unique at the national level for each citizen
    3. *Bank_AC_Number*: Unique account number at the bank. A student can have multiple accounts or joint accounts. This attribute stores the primary account number.
    4. *Name*: Name of the student
    5. *Hostel_Room*: Room number of the hostel

Answer the following based on the above details

a. Identify the Primary Key
b. Is *Bank_AC_Number* is a candidate key ?

5. Consider the following relational schema:

Owner(aid:integer, aname:string, city:string, street:string)
Cat(bid:integer, bname:string, color:string)
Details(cid:integer, bid:integer, cost:real)

Suppose that in relation Owner above, each owner and each street within a city has a unique name, and (aname, city) forms a candidate key. No other functional dependencies are implied other than those implied by primary and candidate keys. Identify the normal form for the above schema.

6. Consider the relation scheme R = {A, B, C, D, E, F, G, H, I, J} and the set of functional dependencies {{A, B} -> {C}, {B} -> {E, F}, {A, D} -> {G, H}, G -> {I}, H -> {J} on R. What is the key for R?

7. What are the maximum number of superkeys for the relation schema R(A,B,C,D) with A as the key ? Also list the super keys.

8. Consider a relation scheme R = (A, B, C, D, E, H) on which the following functional dependencies hold: {A–>B, BC–>D, E–>C, D–>A}. What are the candidate keys of R?

9. Let R1 (A, B, C) and R2 (D, E) be two relation schema, where the primary keys are shown underlined, and let C be a foreign key in R1 referring to R2. Suppose there is no violation of the above referential integrity constraint in the corresponding relation instances r1 and r2. Which one of the following relational algebra expressions would necessarily produce an empty relation

1) $\Pi_D (r_2) - \Pi_C (r_1)$

2) $\Pi_C (r_1) - \Pi_D (r_2)$

3) $\Pi_D (r_1 \bowtie_{C^1 D} r_2)$

4) $\Pi_C (r_1 \bowtie_{C = D} r_2)$

10. R(A,B,C,D) is a relation. Explain in detail if AB->C, C->AD is a lossless join, dependency preserving BCNF decomposition?

11. Answer the following questions

a) Describe the characteristics of a table that violates first normal form (1NF) and then describe how such a table is converted to 1NF.
b) What is the minimal normal form that a relation must satisfy? Provide a definition for this normal form
c) Describe an approach to converting a first normal form (1NF) table to second normal form (2NF) table(s).
d) Describe what is meant by full functional dependency and describe how this type of dependency relates to 2NF. Provide an example to illustrate your answer.
e) Describe what is meant by transitive dependency and describe how this type of dependency relates to 3NF. Provide an example to illustrate your answer

12. Consider the following unnormalised schema

Sales Report (Salesperson-No, Salesperson-Name, Sales-Area, {Customer-No, Customer-Name, Warehouse-No, Warehouse-Location, Sales-Amount})

where {} represents a repeating group.

Convert the above schema to

a) First Normal Form
b) Second Normal Form
c) Third Normal Form

Provide details on the dependencies added and removed from the schema when conversion to respective normal form is performed. Also discuss the differences between each schema in detail w.r.t. the normalisation form.

13. Consider the following medication form

All India Institute of Medical Sciences Sri City							
Patient Number _____				**Patient Name** _____			
				Ward Number _____			
				Ward Name _____			
Drug Number	Name	Description	Dosage	Method of Admin	Units per Day	Start Date	Finish Date
10111	Morphine	Pain Killer	10 mg/ml	Oral	50	01/02/2019	01/03/2019
10112	Tetracyclene	Antibiotic	0.5 mg/ml	IV	10	01/03/2019	01/04/2019
10111	Morphine	Pain Killer	10 mg/ml	Oral	10	02/03/2019	05/04/2019

In the above, following are the functional dependencies

a) Patient No → Full Name
b) Ward No → Ward Name
c) Drug No → Name, Description, Dosage, Method of Admin
d) Patient No, Drug No, Start Date → Units per Day, Finish date

Design the schemas in First Normal Form, Second Normal Form and Third Normal Form.

14. Provide the schema in 1NF, 2NF and 3NF for the following form

Order Form			
Order Number	1111	**Date**	1 March 2019
Customer Number	1234		
Customer Address	IIIIT SriCity		
City-Country	SriCity, India		
Product No	**Description**	**Quantity**	**Unit Price**
A123	Pencil	50	INR 300
B234	Eraser	100	INR 200
C345	Sharpener	50	INR 500

15. Analyse the following table

Branch Number	Address	Telephone
A001	8, New Delhi	9811221234, 9811233456, 9822335678
A002	9, Mumbai	9843244448, 982222222
A003	10, Chennai	8787453421
A004	11, Kolkata	983334442111, 3334442111

a) Why is the table not in 1NF
b) Describe and illustrate the process of normalising the data to 3NF
c) Identify the primary, alternate and foreign keys